103

NUCLEAR CONTAMINATION IN THE ARCTIC OCEAN

Y4. M53: 103-81

HEARING

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

OF THE

COMMITTEE ON
MERCHANT MARINE AND FISHERIES
HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

ON

ADDRESSING THE PROBLEM OF EXTENSIVE DUMPING OF RADIOACTIVE WASTE IN THE ARCTIC OCEAN

SEPTEMBER 30, 1993

Serial No. 103–81

Printed for the use of the Committee on Merchant Marine and Fisheries

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NUCLEAR CONTAMINATION IN THE ARCTIC OCEAN

THURSDAY, SEPTEMBER 30, 1993

HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF, COMMITTEE ON MERCHANT MARINE AND FISHERIES,

Washington, DC.

The Subcommittee met, pursuant to call, at 1:20 p.m., in room 1334, Longworth House Office Building, Hon. Solomon P. Ortiz [chairman of the Subcommittee] presiding.

Present: Representatives Ortiz, Green and Weldon.

Staff Present: Jeffrey Pike, Staff Director; Thomas R. Kitsos, Senior Policy Analyst; Mary J. Fusco Kitsos, Chief Clerk/Administrator; Suzanne J. Waldron, Press Secretary; Robert Wharton, Professional Staff; Sheila McCready, Staff Director; John Aguirre, Clerk/Professional Staff; Terry Schaff, Professional Staff; Greg Gould, Professional Staff; Harry F. Burroughs, Minority Staff Director; Lisa Pittman, Minority Counsel; Richard Russell, Counsel; Laurel Bryant, Minority Professional Staff.

STATEMENT OF HON. SOLOMON P. ORTIZ, A U.S. REPRESENTATIVE FROM TEXAS, AND CHAIRMAN, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

Mr. ORTIZ. The Subcommittee will come to order.

Good afternoon. I would like to welcome all of you here today on behalf of the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf.

Today, the Subcommittee meets to discuss the issue of nuclear contamination in the Arctic Ocean. Last year, information began to be released, and earlier this year the Russian Government made available a report providing the first detailed account of the extent of dumping in the Arctic. This report confirmed what many had feared; that portions of the Arctic Ocean have been used for the last three decades as a repository for spent nuclear reactors and other nuclear wastes.

This information has received considerable international attention and has raised serious concerns about the impacts of these materials on human health and the viability of marine resources. Although many estimates of the amount and the extent of this pollution have been made, no agreement has been reached yet on this issue. It is clear that more information and considerable study will be necessary in order to assess this threat.

It has been a year now since this issue gained prominence. The willingness of the Russian Government to provide information and participate in the search for ways to mitigate this problem has resulted in several international conferences and a variety of ideas and plans. Recently, a scientific expedition was made to determine the status of a sunken Russian nuclear submarine off the coast of Norway.

Today, we hope to hear an update on the progress made in both the scientific and international policy areas to understand, assess, and address this very serious problem. We had hoped to have a witness from the Russian Federation join us today, however, due to the political situation over in Russia, this was not possible.

I would like to welcome all the witnesses and thank everyone for their participation in this hearing.

At this moment, I would like to yield to the Ranking Member of this Subcommittee and my good friend, Mr. Weldon, to make any statement he would like to make.

STATEMENT OF HON. CURT WELDON, A U.S. REPRESENTATIVE FROM PENNSYLVANIA, AND RANKING MINORITY MEMBER, SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

Mr. WELDON. Thank you, Mr. Chairman, and let me thank our witnesses for coming today. I want to thank you today for holding this important oversight hearing. As Chairman of the Committee, your consistent leadership on issues of great importance to the Gulf of Mexico and the world's ocean environment is laudable and we greatly appreciate it.

The breakup of the former Soviet Union has exposed an environmental catastrophe. In the last several years, the Western world has been shocked by the severity of pollution and chemical contamination in the air, soil and water behind the Iron Curtain.

Now we learn that chemicals are not the only dangerous pollutants carelessly released by Russia's former Communist regime. Since 1991, when the last official denials finally ended, we have learned of the extensive dumping of radioactive waste in the Arctic Ocean.

In March of this year, a report commissioned by Russian Republic President Boris Yeltsin outlined a four-decade-long history of illegal nuclear dumping in the Arctic Ocean. Since 1965, the Soviet Union has dumped several million curies' worth of radioactive waste in the waters of Kara and Barents Seas. This total is more than double the total amount of radioactive waste dumped worldwide since the dawn of the nuclear age.

The waste took several forms, including possibly as many as 20,000 canisters of solid nuclear waste and almost 200,000 cubic meters of radioactive liquid waste. Also dumped were 18 nuclear reactors from seven submarines and an icebreaker.

When I say 18, there are discrepancies in the media reports. One report I read said 15, another said 18. One of the issues we have to deal with today is what are we talking about? Do we even know the scope of the problem?

Six of the reactors contained spent nuclear fuel, as did the reactor screen from the icebreaker. Recent scientific assessments of the level of danger posed by the waste, although encouraging, give an incomplete picture of the near- and long-term dangers posed by radioactivity to the Arctic environment.

Last summer, a joint Russian-Norwegian expedition, as my colleague pointed out, discovered that the concentrations of dangerous radionuclides in the waters surrounding the destroyed nuclear reactors are low. The joint research expedition, however, was not allowed within 12 kilometers of the dumping grounds, raising serious concerns about the West's ability to adequately monitor the sites.

Equally troubling is the fact that today Russia still seems to lack the capacity to safely store or reprocess its nuclear waste, and we can quote leading Russian officials, which I will do during the hearing today, who have stated that the Russian navy—as a matter of fact, Mr. Lystsov has said the Russian navy currently lacks the capacity to store and dispose of nuclear waste generated by their ships.

Nuclear waste continues to be discharged into the Arctic Ocean by nuclear weapons plants along the Ob River. Serious concerns exist that dramatically increased levels of radioactivity may soon flow into the Ob and subsequently into the Arctic from the region surrounding the Chelyabinski–65 and Mayak military complexes in the southern Urals.

This spring Russian scientists confirmed that radiation from these military complexes, equal to nearly twice that released in the 1986 Chernobyl accident, has accumulated in the sediments of Lake Karachai. The radioactive pollution from the lake is migrating rapidly into tributaries of the Ob River.

The Arctic as an ocean environment is relatively small and closed. Yet, the health of the Arctic Ocean plays a vital role in the life cycle of countless marine species. From puffins to polar bears, the Arctic is a global resource which must be preserved. No one understands or can speak more eloquently about these vital resources than the distinguished Congressman from Alaska. I am pleased we will have the benefit of his wisdom at this hearing today.

Also within the Arctic Circle are the remains of the *Komsomoles,* a Soviet nuclear submarine carrying nuclear tipped torpedoes which sank off the Norwegian island of Spitsbergen in 1989. Dr. Hollister had an opportunity to take part in an international expedition to investigate the *Komsomoles* this summer, and I look forward to hearing his insights on the potential dangers posed by this submarine.

But beyond that, and perhaps this is not something our witnesses want to address, but I will press this issue with the Navy, also as a member of the Armed Services Committee, is the issue involving, as Dr. Menshikov raised, the United States nuclear powered ship, the *Scorpion,* which, as we know, sank 400 miles off the Azores in 1968 in waters more than a mile deep. Two nuclear torpedoes were supposedly on that vessel as well. That issue has to be addressed also and needs to be looked at by this Committee, and I will be asking appropriate questions of the witnesses in regard to the *Scorpion* as well as the *Komsomoles.*

I would like to again compliment the Chairman for holding this hearing and look forward to hearing from our distinguished panel of experts.

I will be looking specifically for whether or not we have good, hard data that everyone can agree on. How many reactors have been dumped; 15, 18, 21? I am looking forward to hearing your testimony. What is the status of the *Scorpion?* What is the status of the *Komsomoles?* And what is the status of our understanding of the lack of the Russian's ability to store and deal with the nuclear wastes that they are currently generating?

I thank you for this opportunity and I look forward to hearing from our witnesses.

Mr. ORTIZ. Thank you. I would like at this moment to include the statement of our good friend Jack Fields for the record, and also the statements of any other member who will be coming in later on.

If no objection, so ordered.

[The statement of Mr. Fields follows:]

STATEMENT OF HON. JACK FIELDS, A U.S. REPRESENTATIVE FROM TEXAS, AND RANKING MINORITY MEMBER, COMMITTEE ON MERCHANT MARINE AND FISHERIES

Mr. Chairman, I want to compliment you for holding this important hearing on nuclear contamination of the Arctic Ocean.

As you know, our colleague, Congressman Weldon, the ranking Republican member of the Subcommittee, has been deeply interested in this issue for a number of years and he has been a leading advocate in Congress for investigating and cleaning up any environmental damage caused by the former Soviet Union. This hearing is a tribute to his efforts and I hope the world community will stop ignoring this serious problem.

Furthermore, our colleague, Congressman Don Young, whose district abuts Russian territory, also has a long-standing interest in Arctic issues. Mr. Chairman, we welcome your consideration of our ideas and appreciate the great level of cooperation.

The evidence of haphazard disposal of radioactive waste and nuclear weapons in the Arctic Ocean by the former Soviet Union is troubling. Ocean-dumped waste respects no political boundaries, as we have seen in the Gulf of Mexico where debris generated in the Caribbean fouls our Texas beaches, and uncontrolled discharges from Mexican factories threaten U.S. fishery resources. I hope that the United States and other countries who have developed environmentally-advanced technologies can assist the new Russian Government in containing and cleaning up radioactive waste, which poses a danger to human health and the marine environment, and help prevent future inappropriate disposal of nuclear waste.

Once again, Chairman Ortiz, thank you for scheduling this hearing. I look forward to hearing from our distinguished witnesses.

Mr. ORTIZ. I would like to welcome a very distinguished gentleman who is the Ranking Member of the Natural Resources Committee and the Fisheries Management Subcommittee of our Committee, the gentleman from Alaska, Mr. Young.

I understand this issue strikes closest to your home State and potentially could have serious impacts on the people and resources of Alaska.

I want to thank you for agreeing to testify before this Subcommittee, my good friend, Mr. Young.

STATEMENT OF HON. DON YOUNG, A U.S. REPRESENTATIVE FROM ALASKA, AND RANKING MINORITY MEMBER, SUBCOMMITTEE ON FISHERIES MANAGEMENT

Mr. YOUNG. Thank you, Mr. Chairman and members of the Committee. I thank you for the opportunity to testify today, and I am not an expert in Arctic science, or any other science, but I hope I can give you some ideas to consider as you continue your oversight process.

Mr. Chairman, I want to congratulate you, as the gentleman, Mr. Weldon, mentioned, for having these hearings. Few people consider the United States as an Arctic nation, yet almost one-third of the State of Alaska—and I happen to say this, that one-third is larger probably than the State of Texas—including my home in Fort Yukon—lies north of the Arctic Circle. Over 25 percent of our domestic oil production comes from Arctic Alaska, and much more is available in ANWR and on the outer continental shelf.

Each year, we harvest nearly one billion pounds of cod, pollock, herring, salmon, and crab from the Bering Sea. We have coal reserves in Arctic Alaska that rival those of the entire lower 48. Without the Arctic, we would be a resource-poor Nation.

However, the most important resource in the Arctic is its people. Tens of thousands of years ago, human beings crossed the Bering Land Bridge and settled in North America. Their descendants can be found today throughout Alaska and the southwestern United States. Some people believe that they traveled as far south as South America. The point is, people have been living in the Arctic for a long time. It is our obligation as the Congress to protect the basic rights of U.S. citizens, which brings me to the topic of your hearing today.

Arctic Alaska may be separated from Arctic Russia by a political border, but geographically the areas are one and the same. And I may ad lib a little here, Mr. Chairman, even during the Cold War, the people of Arctic Russia and the people of Arctic Alaska worked very closely together and were in communication most of the time.

But what goes into the air, water, and the ice of Siberia eventually winds up in Kaktovik and Barrow and Wainwright. In fact, as noted by the U.S. Geological Survey in a workshop on Arctic contamination earlier this year: "Materials, including contaminants, entrained in sea ice can be transported throughout the entire Arctic."

Mr. Chairman, the Congress is constantly wringing its hands about international environmental problems. We worry about the birds in the Philippines, the kangaroos in Australia, the elephants in Africa, the whales in the middle of the ocean. We spend millions of dollars doing who knows what in the Antarctica, which I am sure the penguins appreciate, but not too many other people. But until your hearing today, and again I compliment you, nobody outside of Alaska cared about what was happening in the Arctic, its resources, and its people.

Now that we Arctic residents have your attention and hopefully the public's attention, let me suggest a few things the Subcommittee should consider.

First, let us look at foreign funding. As you all know, Russia has a tremendous environmental problem. Their rivers and oceans are suffering from years of neglect and poor conservation practices. The Arctic area has served as a giant dumping ground for nuclear wastes, chemicals and other materials that would never be allowed into our water. The good news is that Russia has finally become concerned about the problem. The bad news is they don't seem to be doing much about it.

In response, some have suggested we, the Congress, throw a bunch of money at the problem. Unfortunately, it is not that easy. Not only are we unsure of how the money would be spent, we also have to consider that Russia is still building nuclear submarines. If we ease the financial burden of getting rid of the old reactors, that is more money available to build new ones, and I don't think it is a wise use of taxpayers' dollars.

If we are going to contribute to the Russian cleanup efforts, I suggest we do it with in-kind contributions. In other words, don't just send them money, send them U.S. experts who can get the job done right. We have plenty of talent in this country and a lot of which is unemployed. We want to have a jobs program? Let's put Americans to work helping to do the basic research and data collection needed to control this environmental hazard and, if appropriate, to do the actual cleanup.

I know that foreign aid programs are outside the jurisdiction of this Committee, but I think we should consider raising this issue before the appropriate committees.

Second, I think the Committee should look at domestic funding. Attached to my testimony is a letter from Rural Alaska Community Action Program raising the concern about EPA's intent to drop funding for Arctic research. At a time when thousands of American citizens may face serious health problems from radioactive dumping, the agency responsible for monitoring environmental problems is cutting out its own research programs, and I hope you ask that question, is this how we plan to reinvent the government by turning our backs on American people, primarily Alaskans?

Mr. Chairman, in 1964 I can remember an airplane coming to my town of Fort Yukon, a DC–47, loaded with radioactive x-ray blood testing equipment—lead-filled plane—because there was a great suspicion many of us were contaminated because the caribou had been eating the lichen off the rocks that were contaminated by seven atmospheric nuclear tests in Siberia, and the prevailing winds blow into Alaska and it in fact was found that many of the people there had a radioactive count.

I hope you will ask the NOAA witnesses testifying today about the status of NOAA's Arctic program. NOAA and EPA are members by law of an Interagency Arctic Research Policy Committee. NOAA is already active in global change research. If EPA is going to shirk its responsibilities, then perhaps we should give NOAA a stronger, better financed role in looking at Arctic contamination in the Bering Sea.

Finally, we need to give more support and encouragement to the Arctic Research Commission which was established under a bill reported from this Committee. The Arctic Research Commission is supposed to coordinate Federal Arctic research policy. Unfortunately, it is being ignored by the present Administration. The National Security Council is conducting a review on Arctic policy, yet the Commission has had to fight to be included. EPA appears to be avoiding consulting with the Commission on its Arctic budget strategy, yet the law was clear that came out of this Committee: "All Federal agencies shall consult with the Commission before undertaking major Federal actions relating to Arctic research."

I also have attached to my testimony a copy of the resolution passed by the Commission last year on the issues you are examining today. We set up the Commission to do the job, let us give them the support they need.

Mr. Chairman, the Arctic and its people are important to our Nation and the world. Your hearing gives it the attention it needs. I hope you will not stop with just this hearing, but will continue to examine the problems we face as an Arctic Nation.

I want to thank the Committee again and for the ability to testify before you and thank you for your interest. This is crucially important to the people of Alaska. And I will answer any questions, if there are any questions at this time.

Mr. ORTIZ. Thank you for your testimony, Mr. Young.

Mr. ORTIZ. Do we have any questions from members?

Mr. GREEN. Mr. Chairman, I could not let that pass about the State of Texas. We have claimed all the way to Colorado, and it is not too far for us to claim to Alaska, Don. But if you will notice on the Committee, I think we have a Texas majority on the Committee.

But I appreciate your testimony and the concern because even though the lower 48 is a long way away from it, it is our world that we live in and I thank you for bringing it to our attention. It is so important, even to those of us from Texas.

Mr. WELDON. Mr. Chairman, I too want to thank our distinguished colleague and leader on this Committee for his testimony today. He is the single champion for the State of Alaska when sometimes we in the lower 48 who do not fully appreciate that Alaskans own their land, that sometimes the actions we take are insensitive to the concerns of the Alaskan native people.

It is through your voice that you constantly remind us of that, and here is evidence of our lack of follow-up to issues that are very important to your constituents and absolute need for us to respond not just with words but with action. And I will be looking forward to hearing from our panel today, what their response is to the lack of effort in terms of dealing with the problems of the Arctic because I share your concerns 100 percent.

But thank you for coming forward. I know you have a busy schedule and I won't bog you down with questions, but we appreciate your leadership.

Mr. YOUNG. As far as those gentlemen in Texas, I said that tongue-in-cheek. But you have to understand if you are to check the origin of Alaskans, about two-thirds of them are originally from Texas. I have always said if you can get a Texan into Alaska, you have one of the greatest Americans in the world. You cannot miss with a Texan-Alaskan mix.

Mr. GREEN. I was on the steelhead platform, and I noticed they either had Texas accents or they spoke Cajun.

Mr. YOUNG. Is that right?

Mr. GREEN. Thank you.

Mr. ORTIZ. You have pointed out interesting points in your testimony and I want to assure the gentleman that we want to work with you and see if we can find solutions so that we can address this serious problem.

Thank you for appearing before our Subcommittee.

Mr. YOUNG. My pleasure.

Mr. ORTIZ. Now we will give time for the second panel for them to accommodate themselves.

I would like now to introduce the second panel, which consists of representatives of the Federal agencies that have been involved in this issue for some time. I would like to note a representative from the National Science Foundation was not able to join us today, but has submitted written testimony which will be made part of the record.

We will hear first from Ambassador David Colson, who is Deputy Assistant Secretary of State for Oceans; Dr. Leonard Johnson is the Director of Geophysical Sciences for the Office of Naval Research; next is Dr. Ned Ostenso, Assistant Administrator for Oceanic and Atmospheric Research at the National Oceanic and Atmospheric Administration; last but not least is Dr. Bruce Molnia, Chief of International Environmental Studies at the U.S. Geological Survey.

Welcome to the hearing today, and I guess we can begin with Dr. Johnson.

STATEMENT OF DR. LEONARD G. JOHNSON, DIRECTOR OF GEO-ACOUSTICS/ARCTIC SCIENCES DIVISION, OCEAN SCIENCES DEPARTMENT, OFFICE OF NAVAL RESEARCH

Dr. JOHNSON. Mr. Chairman, distinguished members of the Subcommittee, I appreciate this opportunity to discuss the investigation of the disposition and fate of radionuclide additions to the Arctic in recent years. This investigation is the result of a congressionally mandated program for the study, assessment and identification of nuclear waste disposal by the former Soviet Union.

What I would like to do to save some time rather than read my testimony, would be to walk you through the three figures that are at the back of the testimony.

Figure 1 is a chart of the Kara Sea. It shows where the prime dump sites are. RX stands for reactor, FA for fuel assembly, and C for core, nuclear core. This is the heart of the problem.

As we also heard earlier, there are also 17,000 containers of waste which have been scattered about. A large group of those lie underneath the words "Barents Sea" on the left-hand side of your chart.

This is a considerable pile of material and our job, as mandated by Congress, was to look at this, study, assess it and see what is really there. It includes our most recent numbers, as you heard, like 13 submarine nuclear reactors and pieces out of the power plant of the Lenin nuclear icebreaker.

One of the major problems is nuclear effluents into the major rivers, and we have a program on that and I will discuss that a bit later on.

The next chart is a geographic map of the Arctic and I would like to walk you through what we did this summer. We wanted this summer to get a snapshot of what is in the Arctic and so we went to a number of platforms. We formed cooperative programs with some of our international partners, and you will see there in the table the ships, and I will start in the Barents Sea.

The first was a cruise by Ohio State aboard the *Dalnie Zelnie.* That is a small Russian boat out of Murmansk run by their biological station there.

Then there is the *Geolog Fersman.* This cruise was also in the Barents Sea and has extended into the Kara Sea, and the words show the general geographic area. This cruise is still at sea. We have two contractors on board.

Then, the Ob/Yenisey Rivers obviously need attention and Texas A&M chartered a small Russian ship, the *E. Ovsyn,* and they took a number of stations in the estuaries and up the rivers, and we extended this cruise into the southern Kara Sea when we were forced to cancel a Mendeleev cruise. Those people are back and their samples are back.

The Mendeleev was to be our high profile cruise. This was joint between us and the Shirshov Institute of Oceanography in Moscow. It turned out eventually that the Russian navy denied us permission to work where we wanted to work, and because of the restrictions which would have really compromised the science program, we canceled our participation and the ship sailed without us.

It did, however, pick up one graduate student or post doc who was up in Murmansk. And he is a Russian post doc in the U.S., and he got aboard, so we will probably be receiving samples from that ship also.

As we proceed toward the east, we have in our archives, I list there USN. This is a suite of 400 core samples taken in the mid–1960's by the Naval Oceanographic Office, and those are being looked at for any potential contamination, but they cover both the East Siberian and Laptev Sea.

We have people aboard the *Polarstern* who are looking in the vicinity of the Leptev River. It is a German cruise by the Alfred Wegner Institute. They are doing physical oceanography and also marine G and G. Geology and geophysics.

Then we spent a lot of time working in Alaskan waters. Because like the Alaskans, we wanted to make sure that the waters there are clear and clean.

The first ship, Henry Larson, is a Canadian icebreaker. Then there was the U.S. icebreaker, *Polar Star,* who is still at sea. She has been at sea for about two months. We have been collecting samples off her continually. The *Alpha Helix* of Alaska took a large number of samples.

The *Okean* is a Russian oceanographic ship which we had people on board from Oak Ridge. The *Pargo* is a U.S. submarine working outside the 200-mile limit and she collected a large number of samples. She is back now. And ATOK is the name of an experiment down off Kamchatka and that cruise has not yet gone to sea, but we will be collecting samples during that cruise to look at any potential problems in the Pacific Ocean.

The last figure—I see I am out of time already—is just a representative figure on contamination in the Arctic. This is Reindeer Muscle and Lichens. You can see the effect of the mid–1960 bomb test. There were very high levels.

And basically it has wound down so that in the year 1990 we are back on ground and there does not seem to be any contamination up there, except I would expect it might be very localized in some of the fjords, and all the data has shown this.

And there was a meeting alluded to in Kirkenes, Norway, in 1993, August, where there were both Russian, Norwegian and U.S. scientists and they said, and I will quote: "Investigations show that the present level of strontium 90 in the Kara Sea is lower than the levels found in earlier investigations."

The results of this investigation show that at present the influence of dump radioactive waste on the general level of radioactive contamination is insignificant; however, local effects in the vicinity of the dumping sites cannot be excluded.

And this completes my testimony. I thank you for your attention and am more than willing to answer questions.

Mr. ORTIZ. Thank you. We will continue with the witnesses and then when they are finished with the testimony we will go back and the Committee can ask questions.

[The statement of Dr. Johnson can be found at the end of the hearing.]

Mr. ORTIZ. Ambassador Colson.

STATEMENT OF AMBASSADOR DAVID COLSON, DEPUTY ASSISTANT SECRETARY FOR OCEANS, U.S. DEPARTMENT OF STATE

Mr. COLSON. Thank you, Mr. Chairman. I do have a prepared statement and ask that it be put in the record.

Not being a scientist, I believe the best thing for me to do is avoid the strictly scientific issues and the conclusions that may be reached and focus, instead, on six contextual points that I hope will set the stage for the other witnesses.

Let me speak briefly about the international legal situation. As you know, as a matter of domestic law, the Ocean Dumping Act creates, in effect, a ban on the deliberate disposal of high- or low-level radioactive waste by U.S. citizens or vessels in the United States. As a matter of international law, the London Convention, which was previously known as the London Dumping Convention, to which former U.S.S.R. and Russia are party, prohibits the deliberate disposal of high level radioactive waste at sea.

Technically, low level waste may be disposed of if there is a prior special permit. However, since 1985, the parties have put in place a voluntary moratorium on low level waste disposal. At UNCED last summer, the Rio Conference, the world called for the London Convention parties to reevaluate the matter and expedite studies, which are now completed, concerning putting into place a ban of some nature on the disposal of low level radioactive waste in the ocean. That process has begun within the London Convention context and I believe that some conclusion will be reached this November.

But as we know, words on paper and agreements made diplomatically often don't tell the whole story. We now know definitively that the Soviet Union deliberately violated the London Convention high level ban and the moratorium on low level radioactive waste disposal. By all accounts, Russia, while contending it is abiding now by the high level ban, admits that it may be several years before it has in place disposal options on land to deal with its low level radioactive wastes.

In other words, the dumping of low level radioactive wastes at sea proceeds. That is the situation we find ourselves in today.

Second item I would like to mention is the Yablokov report which has been referred to by several members of the Committee. This report is a significant and revealing document prepared at the direction of President Yeltsin and it is from it that we have most of our information as to what was dumped and where.

We certainly need to congratulate Mr. Yablokov and others like him who had the courage and perseverance required to make public the report. But even while saying this, we must note that the report is generalized and it paints with a broad brush.

The picture is clear, but there is much more we need to know. Russia, meaning the entire Russian Government, needs to make full disclosure. At the Woods Hole workshop recently, the participants there identified a variety of data that need to be made available by Russian authorities. It is in Russia's best interest that it do so. Thus, as part of our diplomacy, we must focus attention on gaining access to this information, unlocking those doors that remain closed.

Third, I want to mention briefly that there are some problems still in cooperating with Russian institutions. On a person-to-person, scientist-to-scientist level, cooperation is excellent, but other witnesses on this panel will be able to recount for you the on-scene problems of gaining access to sites, of directly participating in research, even after we thought we had all the clearances needed.

It is in Russia's interest to cooperate with the international community in this regard. Money from other countries and from international institutions will only be available for monitoring, assessment and potential remedial action if there is confidence within the international community that it is getting good data and that the work is being done where it needs to be done most.

Fourth, let me mention briefly two important international institutions that will play an important role. First is the IAEA. This technical agency with the ready expertise has already begun work in the Barents and Kara Seas and is considering a project in the north Pacific.

The other institution is the Arctic Environmental Protection Strategy, the AEPS, begun in 1991 by the eight Arctic countries. One part of the AEPS program is something we call AMAP, the Arctic Monitoring and Assessment Program. It has begun work to monitor a range of pollutants in the Arctic through coordinated national programs, one of them being a radioactive waste monitoring program.

Both IAEA and AMAP have an important role to play but they can only do as much as the governments concerned are prepared to direct in terms of funding and in terms of political direction.

Fifth, I would like to say something about the interagency process within our government. There is no lack of interest or enthusiasm within the agencies in establishing programs to tackle this problem, but we are all mindful of the very real budgetary constraints we all face and the prioritization that must occur between and among the many needs that must be addressed.

The big question we all face at the agency level, at the Administration level, and at the congressional level is just where does this issue of radioactive contamination in the Arctic stand on that priority list. If the $10 million in fiscal year 1993 funds made available to DOD for this purpose had not materialized, we would have been left in this past year with being able to do little more than to put words into communiques and press releases and talking about the importance of studying the problem.

The basic question we need to face as a Nation remains just how much can the United States do or should do in this area. We don't have the answer to that question at the time and it is one we are continuing to grapple with.

Finally, let me just finish off by noting we must place the ocean disposal of radioactive waste into context. A problem, to be sure, but we suspect that the pollution entering the Arctic from Russia's rivers poses perhaps a bigger potential problem, and as well, that pollution from heavy metals and other compounds could bring about environmental consequences at an early date.

Mr. Chairman, the Arctic is important to the United States. Its fishery resources in the Bering Sea alone are the foundation of a multibillion dollar industry. Its living resources provide subsistence for native people along the coast of Alaska. The marine mammals, birds, and other living resources in the ecosystem of which they are a part must be protected from the contamination deliberately caused by man.

We are all mindful of the political and economic crisis that Russia faces but there is an environmental one as well and we all need to do our part to see that it is adequately addressed.

Thank you, Mr. Chairman.

Mr. ORTIZ. Thank you.

[The statement of Mr. Colson can be found at the end of the hearing.]

Mr. ORTIZ. Dr. Ostenso.

STATEMENT OF DR. NED A. OSTENSO, ASSISTANT ADMINISTRATOR FOR OCEANIC AND ATMOSPHERIC RESEARCH, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dr. OSTENSO. Chairman Ortiz, Mr. Weldon, and Mr. Green, it is always a pleasure to appear before your Subcommittee. It is particularly a pleasure to be associated with this panel, which is distinguished in its own right, but who I also count amongst my old friends, and I would like to identify very much with the statement that Ambassador Colson made. The former Soviet Union has abused its environment in an awesome manner, many aspects of which are pernicious in the extreme. Included in that is the dumping of radioactive wastes, both purposefully and inadvertently, in the Arctic, as outlined by Dr. Johnson.

One of the themes in my testimony is that we have to look at the entirety of the problem and not just the individual pieces. The best of our understanding, which I emphasize is not complete yet, is that the radionuclide pollutants in the Arctic Ocean are a chronic problem and possibly worse. The pollutants on the terrestrial Arctic and further south in many cases are pernicious and have the potential of developing acute problems in the Arctic Ocean. So we must address the problem in its full context.

NOAA, as an agency, is concerned with this issue for a number of reasons. One is that we assume the responsibility of understanding how the global environmental system works as a whole, and we have explicit responsibility for marine resources. And, finally, we have some unique capabilities that can and should be recognized in addressing this problem. These things include such things as the Marine Mammal Tissue Archive, the National Status and Trends Program, and our Climate Monitoring and Diagnostic Laboratory and its global sampling stations.

We have satellites that are appropriate for monitoring activity in the Arctic, and large numerical modeling capability at the Geophysical Fluid Dynamics Laboratory. Jointly with the Navy, we operate the Navy/NOAA Joint Ice Center. We also were instrumental, with the support of the other agencies, in rescuing much valuable oceanographic data, including data from the Arctic, with the breakup of the Soviet Union.

Also, by robbing the petty cash fund, we were able to mount a small expedition with the Kolyma-Idigirka Aviation Enterprise located at Cherskiy in the Soviet Far East to do some aerosol sampling in the Arctic.

The other point I would like to make is that as we struggle to address these problems, we must do so in the context of all the other issues that are weighing upon us, such as global warming; stratospheric, tropospheric and surface layer ozone problems; a research fleet, as you know, that is 30 years old, and so forth. Putting all of these issues in the context of national priorities, as the Ambassador pointed out in his second to last point, is a very relevant matter.

In addition, there are other capabilities that all the agencies have that could be further deployed to this effort, but, again, it must be done in the context of the total problem and in the context of available resources.

The international fora that seems to be the fora of choice to address the eight Arctic nations' interest and concern—and by extension the world's interest and concern—in Arctic radionuclide pollution, is, as Ambassador Colson pointed out, the Arctic Monitoring and Assessment Program (AMAP) of the Arctic Environmental Protection Strategy. NOAA is one of the co-chairs of the U.S. involvement with AMAP, and we try to work with other agencies using available resources to leverage our capability to address this problem.

Finally, NOAA is explicitly responsible for the bilateral agreement with the former Soviet Union, and now with the Russian Federation on Ocean Research. We had the first meeting of that bilateral committee with the Russian leadership in Seattle back in July. Among other topics, we addressed the radionuclide contamination problem. They share our concern, and we identified some programs to further examine it.

Finally, I would be remiss not to make a point which Dr. Johnson, I think, is too modest to make. Which is, that although Dr. Johnson had the largest source of available funds through the FY 1993 DOD appropriation to address the problem in question, he never hesitated to involve and coordinate with all the relevant agencies. He went out to the entire talent pool of the Nation, indeed the world, to participate in this program. It had many parts to it, lots of problems, enormous success, and although it was sponsored by the Office of Naval Research, it was truly a national effort thanks to Dr. Johnson.

That finishes my summary. With your permission I will submit my full testimony.

Mr. ORTIZ. Thank you Dr. Ostenso.

[The statement of Dr. Ostenso can be found at the end of the hearing.]

Mr. ORTIZ. Dr. Molnia.

STATEMENT OF DR. BRUCE MOLNIA, CHIEF OF INTERNATIONAL ENVIRONMENTAL STUDIES, U.S. GEOLOGICAL SURVEY

Dr. MOLNIA. Thank you, very much.

I would like to say to you, Mr. Chairman, and members of the Subcommittee, that I am here in my capacity as the Chairman of the Interagency Arctic Research Policy Committee's technical committee that established the U.S. workshop on Arctic contamination, and I will try to restrict most of my comments to what transpired at that workshop.

From May 2 to 7, the Interagency Arctic Research Policy Committee conducted a workshop on Arctic contamination in Anchorage, Alaska. The workshop evaluated the issue of contamination ranging from radionuclides as well as trace metals, persistent organic compounds and hydrocarbons. The workshop was attended by more than 250 participants from the U.S., Canada, the Russian Federation, Norway, the European Economic Community, Finland, Great Britain, and the International Atomic Energy Agency. Twenty-five Russian scientists and governments' representatives prepared presentations for the workshop.

And in fact, Mr. Chairman, the proceedings, and this is the camera-ready copy that has been sent to the printer, will be published as a special issue of Arctic Research of the United States. This is the Interagency Arctic Research Policy Committee's special publication, actually semiannual publication, dealing with U.S.-Arctic involvement, and that should be available in November. We will make sure that the Committee does get a copy of that.

The goal of the workshop was to provide U.S. Government decisionmakers with a factual basis for formulating U.S. policy on Arctic contamination. To reach this goal, the workshop attempted to identify sources of existing data and information about Arctic contamination, identify the breadth of these data, identify major data gaps that need to be filled to complete a thorough analysis of the characteristic contamination question, and to begin the process of determining whether specific Arctic contaminants present a risk to the environment, ecosystems, or human health in Alaska, the entire Arctic, and the global environment.

A principal focus of the workshop was to understand the disposal of the radionuclide waste of the former Soviet Union. This was done with the full cooperation of the Russian Federation. In a letter of welcome and cooperation, Russian Federation Ambassador

Lukin stated Russia has been "taking and will take the necessary measures in the interest of monitoring and stabilizing the ecological situation in the northern and far eastern seas." He continued, "There is a strong understanding in Russia that global recognition of this problem is a natural basis for expanding the mutually beneficial cooperation in this field with all concerned countries."

Vitaly Lystsov, from the Russian Federation's Ministry of Environmental Protection, presented a summary of the Yablokov Commission report. The report is entitled "Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territories of the Russian Federation." The report describes the dumping, disposal and loss of liquid and solid radionuclide wastes—many of which were disposed of in sealed containers and may not be leaking at present—nuclear submarines, and fueled and unfueled submarines and icebreaker reactors in the Arctic Ocean's marginal seas.

The report identifies that more than two million curies of radionuclide wastes were dumped into the Kara and Barents Seas alone. The report also identifies that radionuclide wastes were dumped into the northwesternmost Pacific Ocean, the Sea of Okhotsk, and the Sea of Japan, as well as into Russian rivers which drain into the Arctic Ocean.

Prior to the release of the report, we were unaware of the disposal of radionuclide waste in the northwesternmost Pacific Ocean, the Sea of Japan or the Sea of Okhotsk.

Workshop participants presented detailed information about radioactive and toxic wastes that were dumped from former Soviet Union nuclear facilities into adjacent rivers and lakes. Chronic problems were described at some of these facilities, including the continuing leakage of waste. Observed concentrations of both trace metals and organic contaminants in western and central Siberian rivers, especially the Ob, the Lena and Yenisey, substantially exceed the maximum limits of Russian Federation law. Little information is available about the eastern Siberian rivers or the disposal of radionuclide material into the Laptev, East Siberian or Chukchi Seas.

At the time of the workshop, virtually no information existed about the status of the radionuclide waste materials dumped at any of the former Soviet Union dump sites. Most sites had not been investigated in more than 25 years. Kara and Barents Sea samples collected at locations substantially distant from the dump sites did not show elevated levels of radioactivity, suggesting that, to date, no significant movements of contamination or contaminants have occurred.

Not all radioactive contamination results from human activities. One Russian presentation identified that in some Siberian oil and gas production areas, permafrost processes concentrate natural radioactivity in brines, resulting in radiation levels up to an order of magnitude above maximum acceptable levels.

Workshop presentation also confirmed not all Arctic contamination is as a result of activities of the former Soviet Union. Presentations identified sources of radionuclide contamination from beyond the Arctic, including radioactivity entering the Barents Sea from nuclear fuel reprocessing plants in northwest Europe. Waste disposal sites were also identified in Alaska as well.

An analysis of the information presented at the workshop shows on a regional basis there is not enough credible scientific information available to conduct a comprehensive risk assessment to determine the effects of Arctic contamination on ecosystems and human health. The magnitude of long-term risk resulting from Arctic dumping to aquatic ecosystems, terrestrial ecosystems, and human populations in the Arctic and beyond is unknown.

Surprisingly, there is a general absence of systematically collected scientific information about contaminant type, distribution, transportation and fate throughout the Arctic, and no systematic program exists to monitor U.S.-Alaskan waters.

One report of a highly radioactive piece of metal found at Novaya Zemlya beach suggests that sea ice may be impacting dumped materials and may be redistributing and transporting nuclear materials from their initial disposal sites. Materials including contaminants, entrained in sea ice, can be transported throughout the entire Arctic.

Let me close with one other statement that is not in my testimony. One of the presentations discussed the Chernobyl accident, and Glen Shaw, from the University of Alaska, who is an expert on Arctic haze, pointed out if the Chernobyl accident had occurred three or four weeks earlier, the winter circulation pattern that feeds the Arctic haze would have transported a large amount of the Chernobyl nuclear waste across the North Pole into the U.S. and Canadian arctic. Fortunately for the U.S., the winter circulation pattern had dissipated and we were in more of a spring-summer type of circulation pattern and, consequently, a lot of these contaminants ended up in Europe and, fortuitously, did not make their way into the U.S. Arctic.

I would be happy to answer any questions or expand on anything I have said. Thank you, sir.

Mr. ORTIZ. Thank you.

[The statement of Dr. Molnia can be found at the end of the hearing.]

Mr. ORTIZ. I think that the Committee has heard some very interesting testimony, and at this time I would like to open it up and I will ask a few questions and then yield to the members of the Committee for questions that they might have.

For Ambassador Colson. I read an article recently which stated that the Russian Government has earmarked something to the tune of $12.5 billion for new vessels. Mr. Young touched on this point earlier, that the Russian Government seems to find plenty of funds for new construction, while appealing to the world community for funds to clean up existing problems.

What has the State Department been doing to address this problem and could you describe how U.S. bilateral and multilateral Russian aid is coordinated with Arctic environmental protection efforts and how the State Department is involved?

Maybe you can give us some input as to what the State Department is doing with these problems that we have.

Mr. COLSON. As you know, Mr. Chairman, the Vice President has begun to engage the Vice President of Russia on subjects such as this, and I am not fully briefed on the most recent of those conversations, but would be very happy to see if we can give you a more complete answer in a written response. But I think that all of us within the government right now are struggling with the same questions. It is very difficult coordinating with the Russian Government now.

Obviously, we can see the pictures on CNN and so we can see one kind of problem. But, as well, you can talk to one group of people in Russia and you can get a very straightforward answer and some clear direction on how to proceed on a given problem and then you immediately run into a roadblock once you start down that road from another part of that government. So there is a great deal of lack of coordination internally. I am not going to stand before you and say that we know exactly how they are operating and that we are putting the pressures on where we might best do so from an environmental perspective.

Certainly this question about Russia continuing to build nuclear vessels when they don't have the capacity in inland-based facilities to address the disposal questions that they must, is a very troubling issue.

Mr. ORTIZ. Now, I have a question for Dr. Ostenso.

You mentioned in your testimony that NOAA is a co-chair of the Arctic Monitoring and Assessment Program. Has the new Administration been supportive of this program and how will NOAA be involved through its participation? Maybe you can touch on that.

Dr. OSTENSO. Yes. Being supportive of an effort and being able to find the resources to back that support are really what is at question here.

As we come before the Congress in multiple fora, the thing we most get criticized for is not doing enough, and this is just one of the realities of the budget with which we are all struggling.

The Administration does recognize the effort, my Administration does, and is doing the best it can to martial what resources it can to support that effort.

The answer is that the agencies, all the agencies that have a stake in this problem, are working very closely together. Our communication is both formal, through the IARPC, and informal through old acquaintances and alliances. We are as closely coordinated as I think we possibly can be and we are, I think, getting the biggest bang for the buck with the resources we have, as Dr. Johnson pointed out, using vessels from figuratively all nations of the world where we can get the best deal.

Mr. ORTIZ. I just have one more question and then I will yield to Mr. Weldon and then Mr. Green for questions.

Now, can any of you give us some idea of the integrity of the waste containers and reactors which have been dumped and how high is the risk of significant leakage from these containers? Anybody who would like to respond to that.

Dr. MOLNIA. I can give a partial answer to that.

Once the question was raised by Mr. Weldon, I went and looked in the Yablokov Commission report to see what they defined in terms of number of reactors and they identify 17 reactors; 10 which they say were disposed, with no spent fuel, in the Northern Seas; five disposed with spent fuel in the Northern Seas; total of 15 in the Kara and Barents Sea area, and another two in the Russian Far East without spent fuel. Total of 17.

I don't know whether the discrepancy in items comes from whether you are talking specifically about the Arctic or talking about what the report identifies. The report has a minimal amount of information in areas other than the Kara and Barents Sea. And there may be much more.

In fact, one of the concerns that we have is the tremendous discrepancy between the number of curies, megacuries, in fact dumped in the Arctic and the very small amount of radionuclide waste that has been identified in the western Pacific and other regions.

So that is an answer to the first part.

In terms of the containers, there is virtually no information that was available at the time of the workshop. I would think that Russia, participating through the IAEA, may have provided additional information, and there may be some information about the types of containers, when they may leak or whether they would leak.

The reactors, in general, were prepared and were filled with an organic polymer to further elongate or prolong their life before leakage started.

Mr. ORTIZ. See, it concerns me because, do we—how long will it take or how much more investigation will it take to really determine if this is really—is it spreading out? Is it moving? Is it down at sea?

For somebody who is just a layman, who does not understand this problem, it is very serious. I think we are dealing with a very serious problem here. Maybe we just don't understand how serious this is. Maybe I am wrong.

Dr. MOLNIA. We in the scientific community, I think, and in the Federal Government community, who are trying to get answers to these questions, are also frustrated and perplexed because, as you heard, this year's efforts by the Office of Naval Research to gain access to the dump sites and to try to answer the questions you are posing with firsthand information were thwarted by the Russian navy. So we are also as ignorant now as we were before the start of the summer.

We have a lot of information the Russians have given us, but we do not have key answers to specific questions such as the one you just posed.

Mr. ORTIZ. Thank you, Doctor.

Dr. OSTENSO. If I might add. The question you ask is a profoundly important one but it is complicated for several reasons. One relates to the question of what is there, what is it contained in, and what is the life expectancy of its containment. Another relates to the surrounding natural physical and biogeochemical environment. What are the currents? What is the sedimentation rate? What is the character of the sedimentations? Is it highly absorptive clay material or others?

And, finally, what is the degree of bioabsorption, bioavailability and biotransport of the material? I think Dr. Hollister will be saying something about these matters.

So there are the two basic problems: One, if you will, the hardware part of the problem, and, second, the environmental part of the problem. Furthermore, the Arctic environment in the areas of concern is not very well understood. It is ice-covered and hard to get to. It was under the political control of the Soviet Union for years. And the shallowness of the sea exacerbates the variability of the environmental conditions.

Mr. ORTIZ. Thank you.

Dr. Johnson, would you like to add something?

Dr. JOHNSON. Let me say a few words. As part of our study we did things other than go to sea. We engaged a fellow by the name of Mark Mount at Lawrence Livermore to do modeling. He has the proper background and he is looking at how fast a container will corrode based on the best information that he can get in regard to the container itself.

This summer the *Geolog Fersman* will visit some of the dump sites and is equipped with cameras. They plan to photograph anything they can, and especially the reactors. There was a joint Norwegian-Russian cruise which also had camera facilities to look at the dump sites in some of the fjords, so we anticipate getting some corrosion figures from these cruises.

We are also doing modeling of pathways. If this stuff does leak, where will it go? We have a modeling effort under way. We already have preliminary results. And perhaps to make you feel more easy, as you may know, the U.S. Air Force dumped a couple of atomic bombs in Thule Harbor. That is up in northern Greenland, and that was many, many decades ago, in the late 1940's, 1950's, I guess, and the contamination up there is monitored every four years and has stayed very, very localized.

Now, part of that might be just local effects, because it is a small harbor, but our feeling is that the stuff may tend to stay where it is put unless it is picked up by strong bottom currents or sea ice. And we are definitely working the pathway problem with an eye toward monitoring.

At some point we will have to monitor, and where will we put monitoring stations? Obviously, we will be resource limited. We will not put in 5,000. We will probably be lucky to put in five. So we want to know where the best places are to monitor, especially in regard to material moving toward Alaska.

Mr. ORTIZ. Anybody else? Mr. Weldon?

Mr. WELDON. Thank you, Mr. Chairman.

I want to thank our witnesses for their testimony and for their insights. I am not a scientist, and I don't want to be an alarmist, but listening to some of the testimony today concerns me.

Dr. Ostenso, in your statement you refer the Lablokov Commission report, which states that the Russian Federation has admitted to dumping radioactive material. You go on to say that currently in the vessels in the Murmansk Harbor, there are solid wastes of 10 million curies of radioactivity.

By comparison—I come from Pennsylvania—the Three Mile Island incident, which was an international incident, released 15 curies. Here we are talking 10 million curies sitting in storage in Murmansk.

I don't want to be an alarmist, but it sounds to me like we have got a real potential problem sitting there. We better get moving quickly both in terms of raising the awareness of our government and the Russian Federation. That is alarming to me. It is of great concern. And I will ask for your response.

But I want to ask a couple of questions. I would like to submit some for the record, Mr. Chairman.

First of all, Ambassador Colson, you mentioned the Mendeleev cruise and the fact we weren't able to participate. Is it because we objected to not being able to get close enough to the site? Why were we not involved in that cruise when it left?

Mr. COLSON. Yes, sir. That was basically the problem. We had assumed we would get access to some of the important sites but we were to be unable to get access to those sites if there were U.S. persons on board the vessel. So the decision ultimately made was to pull the U.S. persons off and let the ship proceed without U.S. participation.

Mr. WELDON. So the ship and cruise did go to the site but without U.S. involvement?

Mr. COLSON. I can't verify it did go to the site. It was our hope it would go with Russian scientists aboard and go ahead and—Dr. Johnson tells me the answer is no, it did not go to the site.

Dr. JOHNSON. It went elsewhere.

Mr. WELDON. That is a concern right there, the Russians are telling us they are cooperative, and obviously this is not indicative of a mood of cooperation, while asking for dollars and assistance to help them assess the enormity of the problem.

In your testimony, you also mention that we had put I think $25 million into an international science and technology center in Moscow. Is that correct?

Mr. COLSON. Yes, sir.

Mr. WELDON. Yet they are refusing to allow us to work with them in terms of doing an in-depth assessment of what the scope of the problem is. That is of great concern to me and it coincides with what Congressman Don Young said in his testimony.

On the other hand, you know, we are asking for complete candor from the Russians, and I have to ask this question as a member of the Armed Services Committee and this Committee of a statement made in a news conference by an ecologist and a member of the Supreme Soviet, Dr. Valerij Menshikov. He said, I hope the United States will be as open about the *Scorpion,* a nuclear submarine that sank 40 miles off the Azores in 1968 with two nuclear torpedoes.

So this question is for you, Dr. Johnson. Have we ever issued a report on the *Scorpion,* and what is the status in terms of radioactivity?

Dr. JOHNSON. I cannot answer that question. My office has no program there but we can obviously put it in the record after I have done my homework.

[The information can be found at the end of the hearing.]

Mr. WELDON. Mr. Chairman, we both sit on the Armed Services Committee, both are Members of the Seapower Committee working closely with the Navy, have been on R&D and Acquisition. That is an issue I wanted to get into. If we are going to expect candor from the Russians, we better have some candor on our part or we don't have much credibility in asking them to give us full access to their information. It looks to me that has not been the case, at least in the mind of Dr. Menshikov.

I would like you all to respond to the question of funding, which we have heard. There has not been a commitment of this administration or perhaps previous administrations to the problems of the Arctic region and whether or not you feel that we are providing enough funding.

I heard DOD did allocate $10 million. There is another $25 million going into this international science center. I would like to know whether or not you feel we should be putting more money into this area.

I guess, Dr. Molnia, I want to ask you, in the conference that was held, I believe it was in May, were the Alaskans involved at all, were they invited to be involved, and if not, I guess why not?

It seems to me, Don Young has expressed the position that Alaska has felt somewhat left out. I would just ask what role if any did Alaska play in that.

I have asked a lot of questions and I would ask individuals to respond, but I have a lot of questions about where we are, and the ambiguity of how many reactors, one agency saying 17, one saying 18, news accounts say 15. We don't even know what is involved, I don't know how we are ever going to come to grips with how to monitor and deal with it.

But these are concerns that I have that this Subcommittee is not going to let drop. I will submit another series of questions for the record that I would like to have answered.

I apologize for having to run over and vote, but I will be back here. I am going to be very interested in the responses to my questions that you all have.

Dr. MOLNIA. I want to give a specific answer about the State of Alaska's involvement in the Federal workshop. There was quite substantial State and Federal cooperation in this. Mead Treadwell, the number two man in the State Department of Environmental Conservation, was a co-planner. We had representatives from the University of Alaska on our Committee. It was held in Alaska to give the State of Alaska government but also Alaskan natives an opportunity to have their voices heard. I would say it was a successful Federal/State interaction.

One of the problems that the policy committee has had all along has been finding money to continue or expand Arctic research activities. With the advent of concern about Arctic contamination, we have been trying to put together a coordinated Arctic research program, to identify what are the risks to Alaska, and to look at the larger Arctic environment and global environment.

We are in the process of working through the seniors and those of the assistant secretaries who represent each of the agencies in the IARPC to put together a document for 1995 or 1996 funding. We have no guarantee of funding. Right now we only have disconnected individual agency programs. And also let me say the $10 million that the Department of Defense was given this year was a single-year appropriation.

Mr. WELDON. As a member of the Committee, and I know my colleagues share our feeling, they will be glad to help in that process, Congressmen Murtha and McDade, to make sure that funding is available in the future. You have got to give us the levels you are going to need in that regard.

I am not going to cut anyone else off, but another question I wanted to get out was in response to the Yablokov Commission report on the *Komsomolets*. The commission reported that their investigations have led a Russian scientist to state publicly that plutonium could begin leaking by 1995. That is two years away. Do you have any comment on that?

And also in regard to that, Lystsov has warned that the Russian Navy currently lacks any ability or facilities for storing or dispensing of nuclear fuel.

With regard to plutonium leaking by 1995, what is your feeling in that regard? Is that not of concern to us? Do we not have to worry about that?

Dr. OSTENSO. I think Dr. Hollister, based on a cruise just a few weeks ago, probably has something to say about the confusion over the number of reactors on the seafloor. I think there is probably less confusion in total numbers than in how the question is asked, e.g., the number of nuclear submarines that have been dumped on purpose versus the three reactors that were scuttled from the icebreaker *Lenin,* versus the consulate's accident, versus the eight power plant reactors that were dug up. So if the numbers seem uncertain, it is probably partly due to how the question was asked. However, I wouldn't guarantee that we have received a complete inventory.

And finally, regarding your opening statement about not wanting to be an alarmist, I am not sure what the difference is between an alarmist and a realist. The point I tried to make earlier is that when we look at the problem of radioactive wastes that we know have been deposited on the seafloor, we can't forget the broader problem that includes all the Russian submarines that have to be decommissioned. There are something like 200 of them, as I recall. This does not include all the current wastes that are sitting in hulls of ships in Murmansk. Then, there is the obsolete Chernobyl type power plants that are just waiting for their place in the front page of The New York Times, euphemistically speaking. The point is that you have to look at the whole problem.

Mr. WELDON. There are eight other ones besides Chernobyl?

Dr. OSTENSO. I forget the right count now but it is well-known.

Mr. WELDON. I apologize, I can't miss this vote. If you want to continue, the Chairman is going to continue the hearing. I will return as soon as I vote. I apologize.

Mr. GREEN. [Presiding.] Mr. Colson?

Mr. COLSON. Yes, Mr. Chairman, if I might just mention that with respect to the $25 million that the United States has put forward for the science center in Moscow, the objective there was within the Group of Seven context to provide a center for providing effective employment for a lot of Russian nuclear scientists that we thought were better placed in Moscow doing useful work there than perhaps hiring their services out elsewhere in the world.

And this has been one of those programs which I think has been successful because the merit of the program has been realized, and the European Community and Japan have put in more money than the United States has into this particular effort.

So if I recall correctly, I think they jointly have put in $57 million. So there is a real international effort there to provide means for Russian scientists to do useful work and to stay in Russia doing that work.

With respect to the involvement of the State of Alaska, I recently led the U.S. delegation to a meeting in Greenland of this Arctic environmental protection strategy, and the State of Alaska was represented on the delegation, and as well native groups from the State of Alaska were on the delegation.

Finally, I would like to emphasize the importance of reconciling agency budget problems with respect to Arctic issues. Since I have been involved in this, we have seen areas of emphasis for a year and then drawbacks on budgets, then an emphasis for a year, then drawback on budget. We can't conduct an efficient and respectable Arctic policy if we don't have some certainty about where we are going to be one year to another.

We have got to have some effort to know what is going to be available in 1994 and 1995 to do this kind of work, because it just can't be done on sort of a one year to another year basis.

And in this connection, the Administration has been looking at the issue carefully, and we are trying to get OSTP and OMB more actively involved so that we can—the agencies can have some assurances that within the Administration's budget there will be an Arctic component that will allow agency programs to proceed.

Mr. ORTIZ. [Presiding.] Go ahead, Dr. Johnson.

Dr. JOHNSON. Just to finish it out with the Office of Naval Research, we do have an ongoing core program in Arctic research. This is basic research, it has been ongoing since the 1940's. I consider it the very best in the world. It has stability. It is now run by Tom Curtin, behind me here, and it is adequately funded.

Mr. ORTIZ. Thank you very much. There is no question that this has been a very, very interesting panel with interesting testimony about something which is very serious. I know that some of the Members have other—they are meeting as conferees, but they do have questions, and I would like at this point to tell the panel we will be submitting some questions for you in writing, and you can respond, so that we can get a better grasp of the problems we are faced with.

I would like to thank you for being with us today.

Mr. ORTIZ. At this point, we would like to move to the third panel because at 3 p.m. there is another committee wanting to use this meeting room and we will have to vacate. Thank you for being with us.

At this time, I would like to introduce the final panel, which consists of representatives of the nonpanel groups which have been involved in this issue. I would like to note that the representative from the State of Alaska and the Environmental Defense Fund were not able to join us today, but they have submitted testimony which will be made part of the record.

Mr. ORTIZ. The first witness for this panel, Dr. Charles Hollister, Vice President and Senior Scientist at the Woods Hole Oceanographic Institution. Then we will hear from Clifton Curtis who is the Oceans Adviser for the Political Unit of Greenpeace International.

Before we begin, we would like to remind you if we could possibly stay within the five minutes so we will have room for questions, because at 3:00 there is another committee coming in.

Again, I would like to welcome you to this hearing this afternoon. We can begin with Dr. Hollister.

STATEMENT OF CHARLES HOLLISTER, VICE PRESIDENT AND SENIOR SCIENTIST, WOODS HOLE OCEANOGRAPHIC INSTITUTION

Dr. HOLLISTER. It is nice to be home after a month in the Arctic. I was able to return home with samples from the *Komsomolets.* I was able to look at the video taken from the submarine. I was lucky to be with Dutch and Norwegian colleagues as well as a host of Russians who are very excellent scientists.

I want to report that at the present moment I see no environmental concern; release of radioactive material from the *Komsomolets* that is of no concern to the humans or animals living on or around the submarine at this time.

As you know from my written testimony, I have spent 30 years worrying about how mud moves in the ocean. As you also know, mud will be the principal trolley car, or transporting system, for most of the radioactive materials that are of concern to us today.

So if you are going to learn about radioactivity and how it moves in the ocean, you better know how the particles move. By and large the particles come in from the surface and settle on the bottom and stay there, as we heard a minute ago. I suspect that the materials from the *Komsomolets* and other nuclear point sources of high-level radioactive waste such as reactors, and some 55 nuclear weapons scattered around the bottom of the world's oceans, will stay close by because the mud grabs hold of the radioactive material and settles close by.

The problem really now is to prove what I just said. In the precautionary principle that my colleague on my left will probably talk about, I think it is up to the scientific community to aid in that proof. In other words, prove that the material is not moving.

And I think that is a big problem, because right now we do not have the technology to do this and I am very aware of the state-of-the-art of the technology of deep ocean sampling and deep ocean robots. As you know, one of our scientists took a small robot down the grand staircase of the *Titanic.* We have world-class expertise in radioactive contamination measurements at very low levels.

In fact, we have learned about the plumbing of the entire Arctic Ocean largely through our ability to work with very small amounts of radioactive material that have been coming from the reprocessing plants of the United Kingdom, which is, in fact, for your information the only real signal of radioactive material that we can pick out of the entire Arctic Ocean at this time.

So from the scientific point of view, the problem we are talking about now is highly emotional. It is what I would call a problem of perception and a problem of sampling. And from a scientific point of view the sampling problem is the biggest problem. Because quite frankly, we do not and are not able to sample the small amount of fluff, like that which is under your bed, which is the material that might have gone past a reactor and settled onto the sea bottom. We can't now suck or sample that little bit of fluff in order to prove to you there is nothing coming out of the reactors or out of the weapons.

With respect to the weapons on the *Komsomolets,* the torpedo doors have been damaged, and as I indicated in an interview with The New York Times, we found a large hole blown in the front-end of the submarine that has obviously compromised the nuclear weapons that are in the torpedo tubes. These torpedo tubes are open to the environment, and the mud is drifting past and packing slowly into the tubes. We don't have the technology to go inside the torpedo tube to suck a little bit of the mud out that would be right next to the weapon, so we can't tell if the weapon is leaking now. But we certainly could figure out a way to answer that, and I am hoping in the future we will be able to go back.

I hope to go back on the *Keldysh* and take measurements next summer. This is assuming that the funds are available, which by the way they are not at this moment.

To conclude, in the future I feel that we have to keep pointing to the real facts, and the facts are that there are many reactors full of fuel, many weapons lying on the sea bottom, and nobody has yet demonstrated any environmental damage measurable from all of these materials. I think it has to do with the mud holding on to it and the mud staying close by, and the fact that we have learned very recently that the oceans themselves do not vertically mix.

My concern now is that the emotions, the environmentalists, and my colleague on my left from Greenpeace will make a very persuasive argument that we should foreclose any use of any ocean for any radioactive material for all time no matter what. My sense is that to summarily eliminate 70 percent of the planet and the geology below 70 percent of the planet is premature. And I would urge this Administration to hold off and not support a ban on the dumping of radioactive material in the ocean until we can get our arms around the problem.

The Russian experiment to me is a messy experiment—I would have done it differently—but an experiment nonetheless where we can actually begin to prove that radioactive material does or doesn't enter the food chain, and at what rates.

Thank you very much.

[The statement of Mr. Hollister can be found at the end of the hearing.]

Mr. ORTIZ. Thank you.

Mr. Curtis.

STATEMENT OF CLIFTON CURTIS, OCEANS ADVISOR, POLITICAL UNIT, GREENPEACE INTERNATIONAL

Mr. CURTIS. Thank you, Mr. Chairman. It is a privilege to participate in this hearing. This room feels very much like a second home in some ways, having testified here 20 to 25 times over the past 15 years, including several times on this issue, though at a more global level.

I would like to briefly summarize some key points in my testimony and would ask that the full statement be accepted into the record.

Mr. ORTIZ. It will be included in the record.

Mr. CURTIS. The first eight pages or so of my testimony address issues related to scientific unknowns. Two basic themes are presented. One, the existing scientific information about radiation in the region in the Russian North have merely confirmed that up to now no major leakages of radiation has occurred since none has been detected in the water or sediments at some distance from the sites where the reactors with fuel were dumped.

Second, despite the growing body of public information that has come to light in the last couple of years, unfortunately, detailed information about the radionuclide composition of the dumped matter and the state of containment is still absent. Such information is needed to understand what future dangers may arise.

In my prepared statement there are several references to the Russian white book that describe the state of affairs and the need for much more information and analysis.

Similarly, there are statements by Captain Borisov of the Russian Government Committee for Special Underwater Operations addressing those same concerns. There are also statements by Admiral Selivanov concerning the U.S./Russian expedition to the Kara Sea. In light of some of the earlier questions, while I am not saying his statements are necessarily correct, I think they do shed a different light on why perhaps the 1993 expedition was canceled, or at least they provide further food for thought.

Also addressed in my testimony are issues related to retrieval and other remediation measures. In Greenpeace's view, those issues merit much greater attention than has been given to date.

Moreover, with respect to Soviet and Russian dumping, in our view, for the reasons stated in my prepared statement, retrieval should be the first option.

In subsequent portions of my testimony I briefly touch on several other topics. One is the recent Woods Hole Conference that Charlie Hollister alluded to earlier. As noted in my statement, for me and for several other participants, despite the refreshing exchange of views at that conference, as reflected by the papers, formal and informal discussions, a major disappointment was the closing statement prepared by the conveners for a press conference. That statement gave a mistaken impression that environmental and human health risks of radioactive contamination in the Arctic are or will be minimal, at worst. That impression was very troubling given the generally accepted view that pertinent data is sparse to nonexistent, and that systematic monitoring surveys or risk assessments have not been conducted.

Given the earlier suggestion by Dr. Hollister that Greenpeace has some special agenda that is far different from others, I would ask that the hearing record include two letters, one by two EPA scientists and the other by a scientist associated with Texas A&M University, both of which concur with the views I have just stated with respect to the Woods Hole Conference closing statement.

Mr. ORTIZ. I would like to advise the witnesses that if you have any additional testimony from either of you, it will be included in the record.

Dr. HOLLISTER. Thank you. I intend to do so.

[The statement of Dr. Hollister can be found at the end of the hearing.]

Mr. CURTIS. I also would like to mention the conference Mr. Colson alluded to, the Nook, Greenland Arctic meeting earlier this month. In my testimony I reference pertinent statements from that meeting regarding the unique characteristics of the Arctic. In that regard, my statement also addresses some of the concerns Greenpeace has regarding U.S. activities in the Arctic—activities that need attention.

The concluding substantive section of my statement deals with the London Convention. That form already has been mentioned by Ambassador Colson and by Dr. Hollister. From Greenpeace's view, a formal, global ban is needed with respect to ocean dumping of intermediate and low-level radioactive wastes, thereby putting those wastes on the Annex I "blacklist" of substances that can not be dumped at sea..

Let me summarily reference five reasons many governments have given during the London Convention meetings in relation to why such a permanent ban is needed. One, the oceans are a living, interconnected environment that can return radioactive wastes to humans via ocean food chains.

Two, the ocean is a formidable environment. Pressures and temperatures there reach planetary extremes and corrosive powers of ocean waters are legendary.

Three, we still know very little about the oceans, and our scientific knowledge is rapidly evolving.

Four, the oceans represent a "global commons". It is fundamentally unfair for a minority of the planet's population to disproportionately damage shared marine resources and thus deprive the vast majority of their rights.

Five, given a burden-of-proof approach under the precautionary principle, it is very inappropriate to move forward with disposing of such toxic wastes in the oceans given the risks that exist.

Before closing, Mr. Chairman, given the specific references in Dr. Hollister's testimony to Greenpeace, I would like to briefly comment on his mistaken opinions. In reality, what he is incorrectly attempting to do is to make Greenpeace the "scapegoat" for the fact that the international community does not share his pro-dumping views.

As Ambassador Colson indicated earlier today, at the Earth Summit, 172 governments as part of Agenda 21 called for the London Convention parties to move from a moratorium to address this important issue by moving from the existing moratorium to a full ban on radioactive waste dumping in the world's oceans. In the London Convention, all the parties that have spoken to this issue in recent months—more than 20 countries, with the exception of the U.K., France and Japan—have supported a ban, as did the United States through Ambassador Colson in July when he said that our government has "an obligation to support a prohibition of some character."

In the Arctic region, ministers from the eight countries adjacent to the Arctic Ocean who participated in the recent Nook, Greenland Conference on the Protection of the Arctic Environment agreed as well to language calling for a ban on radioactive waste dumping as soon as possible, consistent with the London Convention.

Finally, Greenpeace's view is not an isolated view within the United States and the international non-governmental organization (NGO) community. All the major NGOs who have addressed this issue support the position of a global ban.

In that regard, and as an example regarding views of other NGOs, I would like to endorse the written testimony submitted by the Environmental Defense Fund in relation to this hearing.

For all the reasons stated above, Mr. Chairman, among others, while setting up scapegoats like Greenpeace may allow Dr. Hollister to sleep a little easier, his criticisms just don't jibe with the real world. In fact, his scientific approach is mired in an outdated view of assimilative capacity, allowing for limitless disposal of humankind's most toxic waste in the ocean, and that is not where we are anymore. We live in a different era, guided by a precautionary approach—an approach that reflects a very different perspective about how we relate to and care about the planet. Among other things, there is widespread and growing consensus in the world community of scientists and other decision makers that the precautionary approach requires us not to dump radioactive wastes in the ocean.

On a different matter, let me end by saying, Mr. Chairman, that one of my colleagues, Joshua Handler, Research Coordinator with Greenpeace's Nuclear Free Seas Campaign, has pulled together a collage of slides, photographs from the Russian north and Far East, and other pertinent documents. At some point we would be happy to come and meet with you, other members and/or staff, to provide an informal presentation and discussion of our archives of visual data and data and information.

Thank you very much for the opportunity to participate in this hearing..

[The statement of Mr. Curtis can be found at the end of the hearing.]

Mr. ORTIZ. Thank you.

We just have 10 minutes left. I think we can make it a little interesting. Maybe Dr. Hollister would like to respond and then Mr. Curtis would like to respond back. We will submit some of the questions in writing, unless my good friend Mr. Weldon has a question.

Mr. WELDON. Thank you, Mr. Chairman.

I would like to hear Dr. Hollister respond. While this is obviously an issue where there is vast disagreement, I would hope we would not personalize the testimony today. I don't think that is appropriate. I think I have as grave a concern as anyone on this issue.

I have been in Congress seven years and to my knowledge Greenpeace has never come to me on this issue. I am the Ranking Member on the Oceanography Subcommittee. I found out about this from the media. So while I think it is nice that you make the statements that you do, I think Greenpeace perhaps is not without fault here either. Perhaps I should have gone out to Greenpeace, but maybe because I am a Republican nobody came to me, but I am very much interested in this issue, and I would like to have heard from you before this hearing.

This hearing was not brought about because of Greenpeace. It was brought about because of my staffer's interest in acquainting me with the issue and wanting to find out more information.

Now, turning it over to Mr. Hollister.

Dr. HOLLISTER. I would like to get back to facts and strip the emotion away as well. The emotional part of Cliff's comments I won't even address. The specifics that I think are worth addressing are the letters from EPA and Texas, and they have been addressed. I would like to make sure that the responses be entered into the record.

The Woods Hole Conference is becoming more and more famous and this is the record of note. One hundred scientists from 11 countries came to Woods Hole, and the scientists—I am talking about the scientists, not Greenpeace legal counsel and others—but the scientists came up with a conclusion that Cliff read and disagreed with. All I can say is let the facts speak for themselves.

I certainly think that when he talks about "damage" and "risks" that those terms would have to be quantified. So I would just like to say, I am an oceanographer, I sample mud, radioactivity, and I am giving you the facts and you can do with them what you want, so go ahead with your questions.

Mr. WELDON. The one question I have is still disturbing and troubling to me, the Yablokov Commission report in regard to the *Komsomolets* where they say the plutonium could begin leaking by 1995. My understanding of plutonium is that it offers tremendous potential in a negative sense. Would you respond to that?

Dr. HOLLISTER. Now we get down to facts. I like this. The plutonium that is in the two torpedoes that are in the top two torpedo tubes of the *Komsomolets,* have clearly been compromised or clearly have water surrounding them. They are not yet I think open to the outside world.

The corrosion rates of the torpedo tubes have been quoted by the Russians as being in a failure mode at about 1994, 1995. We have no direct evidence of that. I looked inside the tube with a video camera. The doors appear to be closed. There is going to be corrosion, there is no doubt.

But I want to draw your attention to the fact that plutonium is one of the best, if I could use that word, radioactive materials for deep ocean clays to hang onto. It has the highest fractionation coefficient. The clays grab onto it, stick together and do not let go.

My (and the scientific community's) sense of this whole problem is that the plutonium will hold onto the clay, it will stay close to the torpedo and stay there forever. There is no process that we can put our hands on that says that plutonium is going to work its way up the food chain and get into our lungs where it will do the most damage. Nobody down there breathes air. It passes through the digestive system without damaging even the smallest worm.

My suggestion is that is not a big issue. But it deserves to be monitored, there is no doubt about that.

Mr. WELDON. Mr. Chairman, I have one other question, and either gentleman can respond to this. But in the testimony by Mr. Curtis, there is the raising of the issue of the potential of long keels of ice protruding downwards into the water that can catch, move and break up dump materials. My contention is that it will be stable and it will not be any movement.

This is to me troubling that, in fact, perhaps there has been a phenomena that is present in the Arctic area in the past, which leads to a reworking process in the floors of the sea, especially in shallower areas, which could in fact cause these areas to be moved or perhaps somehow affect the way that would cause them to contaminate the sea area even greater.

What is your response to that? I am asking, that was the testimony of Mr. Curtis. Is this something that you agree with?

Dr. HOLLISTER. Certainly in the shallow areas, where the ice is thick, you may have actually a bumping of the reactors by the ice, and I think it is something we really have to be concerned about.

Mr. WELDON. That troubles me. I mean, I think to dismiss that and say there is not a problem, once again I am not a scientist, but I would ask Mr. Curtis that, too, but it seems as though you are agreeing with him that this in fact could occur. What we are saying about it being a stable environment is perhaps not always going to be the case.

Dr. HOLLISTER. Just one little technical point on this. That ice has been bumping those reactors for 30 years, and so far we haven't found anything that has come out of those reactors to be alarmed about. That is my factual statement.

Mr. CURTIS. Congressman, in addition to addressing this issue in my written testimony, in a brief reading of EDF's written submission, I think they do a real good job of addressing the issue of ice, including ice keels that scour bottom areas in the Arctic Ocean.

Mr. WELDON. Mr. Chairman, now we have to vacate this room, but I want to thank you for this hearing. I think we have raised more questions than we have gotten answers for today. Perhaps we can get a Russian official over here and elevate this issue to make sure we are doing all we can to support the research effort and address the concerns that been raised here today.

I want to thank you for your leadership. As always, you have done a great job.

Mr. ORTIZ. Thank you.

This will conclude the testimony for this hearing. I want to thank you and all the witnesses that made an appearance before this Committee today, and this is an issue that the Subcommittee will follow very, very closely, as more information becomes available. I hope we can all work together to assure an adequate international response to the problem and see that resources are directed in assessing the issue of contamination and providing the monitoring needed to ensure the protection of human health.

Several Committee members and I have questions for the witnesses, and we will appreciate your reply for the record in writing.

[The information can be found at the end of the hearing.]

Mr. ORTIZ. Thank you very much for your testimony.

The Committee now stands adjourned.

[Whereupon, at 2:55 p.m., the Subcommittee was adjourned, and the following was submitted for the record:

STATEMENT OF
DR. G. LEONARD JOHNSON
DIRECTOR
GEO-ACOUSTICS/ARCTIC SCIENCES DIVISION
OCEAN SCIENCES DEPARTMENT
OFFICE OF NAVAL RESEARCH
BEFORE THE
SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO,
AND THE OUTER CONTINENTAL SHELF
ON
THE RADIOACTIVE CONTAMINATION IN THE ARCTIC OCEAN
SEPTEMBER 30, 1993

HOUSE SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO, AND THE OUTER CONTINENTAL SHELF

SEPTEMBER 30, 1993

Mr. Chairman, distinguished members of the Sub-Committee, I appreciate this opportunity to discuss the investigation of the disposition and fate of radionuclide additions to the Arctic in recent years. This investigation is the result of the congressionally-mandated program that responds to the study, assessment, and identification of nuclear waste disposal by the Former Soviet Union...the FSU...in the Arctic Region.

THE REQUIREMENT

This program was formulated in response to Senate Report 102-408 and the requirement of Public Law 102-396, Section 9110 (b) (1), that not less than $10,000,000 shall be available only for the study, assessment, and identification of nuclear waste disposal by the Former Soviet Union (FSU) in the Arctic Region.

THE PROBLEM:

Arctic radioactive contamination sources disposed of by the Former Soviet Union include (Fig. 1):

- 13 submarine nuclear reactors
- 1 complete submarine (K-27) with liquid metal cooled reactor
- 3 damaged reactors from icebreaker Lenin
- 7 of the above plants contain nuclear fuel
- over 17,000 containers of liquid and solid radioactive waste
- power plant and other nuclear process plants effluents into major rivers
- explosion fallout
- additional sources yet to be identified

THE OBJECTIVES:

Consistent with Section 9110 (b) (1) of Public Law 102-396, this research program has the following objectives:

STUDY/IDENTIFICATION OF THE PROBLEM

This activity involves the compilation of existing data on when, where and what radioactive material was dumped in the Barents/Kara Seas, and on the potential for radionuclide releases into the Arctic Ocean from rivers and from the atmosphere. Data on the types of material that have been deposited in the Arctic and their potential for migration will be included in this compilation. The focus will be on identifying the major types and amounts of radioactive materials that have been deposited into the

Arctic. The plan is to collect this data in collaboration with the efforts of other Arctic and Duropean countries, and with the International Atomic Energy Agency (IAEA). This plan also provides partial support for international and inter-agency workshops that will include participants from the Former Soviet Union. One of the products of these workshops will be reports that summarize the available information.

ASSESSMENT OF THE PROBLEM

This activity is determining present and historical background levels for radioactivity in the Barents/Kara Seas and Alaskan waters. Historical data will come from the literature and from the examination of the sedimentary record. Present-day conditions are being determined via water, sediment, and biomass sampling. Validation of information on radionuclide dumpsites in the Barents/Kara Seas will include emphasis on location and description of the sites by rapid non-destructive methods to confirm the validity of the inventory of dumped material suggested by the data obtained under the "study/identification" activity, and to determine whether any leakage is occurring from the waste packaging.

PREDICTION FOR THE FUTURE

This activity will build on the results of the first two elements ("study/identification" and "assessment"), and on the expertise that the Office of Naval Research has nurtured during its decades of support for research on Arctic Ocean processes. The focus of this activity will be on producing a better understanding of the possible fate of released radionuclides due to: (1) transport by currents, (2) riverine influences, (3) biogeochemical cycling, (4) concentration by organisms, (5) interactions with sediments, and (6) transport and interactions with ice.

This activity will include the development of mathematical models for transport processes, and for partitioning of nuclides between water, sediment, ice, and biota.

APPROACH

To ensure an open process, ONR took the following actions:

- 2 Feb BAA issued
- 140 letters of interest requesting a total of $135 million
- 1 May selections made/34 proposals solicited and subsequently funded
- 1 June proposals received
- 1 Oct 93 all funding actions complete

To ensure full coordination of the radionuclide investigation, an inter-agency advisory committee was established which meet regularly to review the program and proposal selection. This committee includes representatives from the Department of State, Department of Interior, Department of Energy, Arctic Research Commission, National Science Foundation, National Oceanic and Atmospheric Administration, Environmental Protection Agency, Central Intelligence Agency, and the Department of Defense. Additionally, Office of Naval Research personnel regularly attend meetings of the Inter Agency Arctic Research Policy Committee (IARPC).

SCHEDULED ACTIVITIES

WORKSHOPS:

- IARPC (Anchorage), May 93
- WHOI, June 93
- Arctic Radionuclide (ARCRAD) 1 Oct 93
- ARCRAD, Dec. 94

To date the following field programs with U.S. sponsorship/participation have been accomplished, are underway, or are being planned. ((R): Russia; (G): Germany; (US): United States; (C) Canada). (Fig 2):

VESSEL	PERFORMER	LOCATION	REMARKS
Dalnie Zelnie (R)	Ohio State Kola Penn.	N. Barents Sea	7 stations field research
Geolog Fersman (R)	Ohio State	Barents/Kara Sea	at sea; plan to do scientific sampling along Novaya Zemlya coast including dump site near Stepanov Fjord
Mendeleev (R)	NRL	Kara Sea	U.S. participation canceled; promise of samples and 1 WHOI Russian grad. student aboard: presently at sea
E. Ovsyn (R)	Texas A&M	Ob/Yenisey River & Eastern Kara Sea	total of 77 stations taken
USN historical	Oregon State	Laptev/East Siberian	400 core samples
Polarstern (G)	SAIC	Laptev	at sea
USS Pargo (US)	Lamont Doherty	Arctic Ocean	60 samples
Alpha Helix (US)	Oak Ridge Lab	Chukchi	50 stations, 150 samples
Henry Larson (C)	Lamont Doherty	Chukchi	100 samples
Polar Star (US)	Oak Ridge/ Lamont Doherty	Chukchi	200 samples
Okean (R)	Oak Ridge	Bering/Chukchi	60 stations

Unnamed Russian	SAIC	N. Pacific	seaward of Kamchatka; cruise in Nov; part of ATOK program

OTHER ACTIONS

The existing data base on artificial radionuclide levels and inventories in the Russian Arctic is being consolidated in a form amenable for input for assessment models on a Geographic Information System (GIS) at NRL. A predictive model of radionuclide dispersal in the Arctic Ocean is under development at NRL.

INTERNATIONAL

The existing U.S. program has also resulted in mutually beneficial interaction with Russian scientists via joint cruise in Russian waters; however the Mendeleev cruise was a major problem. In this case the Russian Navy denied permission for free access to the Kara Sea outside the 12 mile territorial limit to a joint U.S. Russian cruise. This ultimately resulted in cancellation of U.S. participation. Other multilateral efforts, particularly those being conducted by the IAEA are underway and may yield significant results. I will leave discussions of those programs to my colleagues at the Department of State.

STATUS OF ARCTIC OCEAN BASED ON AVAILABLE DATA AT THIS TIME

The limited quantity of radionuclide data available from the Russian Arctic indicates that present levels of artificial radionuclides are low compared to other contaminated marine environments such as the Irish Sea. However, the existing radionuclide inventory data set for the Russian marginal seas, the Barents and Kara Seas in particular, is incomplete and the identities and magnitudes of the radionuclide source terms have not yet been fully determined (WHOI, workshop 1993) (Fig 3).

ISSUES NOT ADDRESSED IN ONR PROGRAM

- Heavy metals
- Hydrocarbons and chlorinated hydrocarbons (PCB's, DDT, Dioxin, etc.)

RECOMMENDATIONS (FROM WHOI WORKSHOP, 1993)

- Recommended that data on the composition, types of containment and physico-chemical form of liquid and solid radioactive wastes dumped in the Barents and Kara Seas be compiled and released by Russian scientists. Of particular concern are the corrosion rates of waste containment vessels in bottom shelf waters of the Arctic Ocean.
- Detailed data sets pertaining to the magnitude and composition of radionuclide levels in nuclear reactors themselves should be compiled and released by

Russian authorities. Site-specific studies of corrosion and degradation of reactor containment systems, including the furfural hardening mixtures used in some instances to isolate reactor cores, should be undertaken.

- In order to understand, sources transport and fate of pollutants released into the Arctic marine environmental data is required to understand natural variability including temporal and spatial variability, local and large scale effects, biogeochemical processes, and climate change. Analysis of existing data should form the basis for collection of new data.

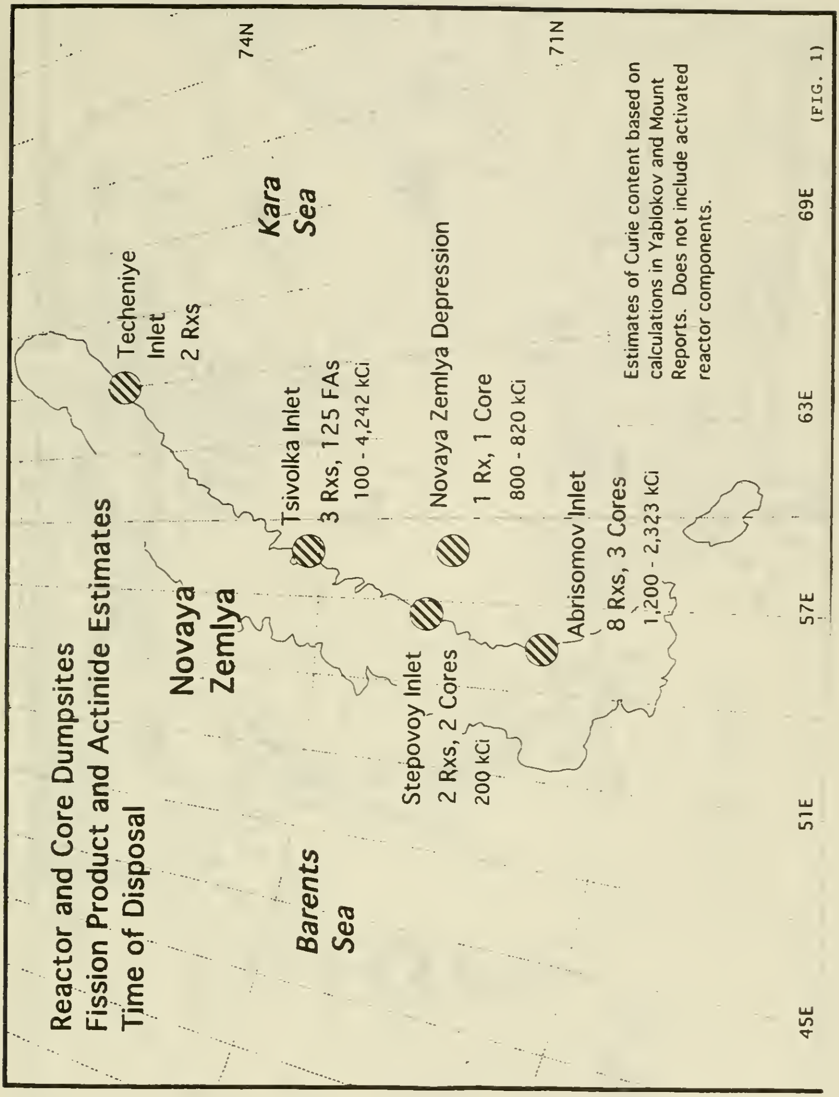
PRODUCTS

SHORT TERM: (1 Dec 1993)
(NRL LEAD ACTIVITY)

- Initial assessment of nuclide levels in Arctic and North Pacific
- Initial assessment of dumped material

LONGER TERM: (1 Dec 1995)

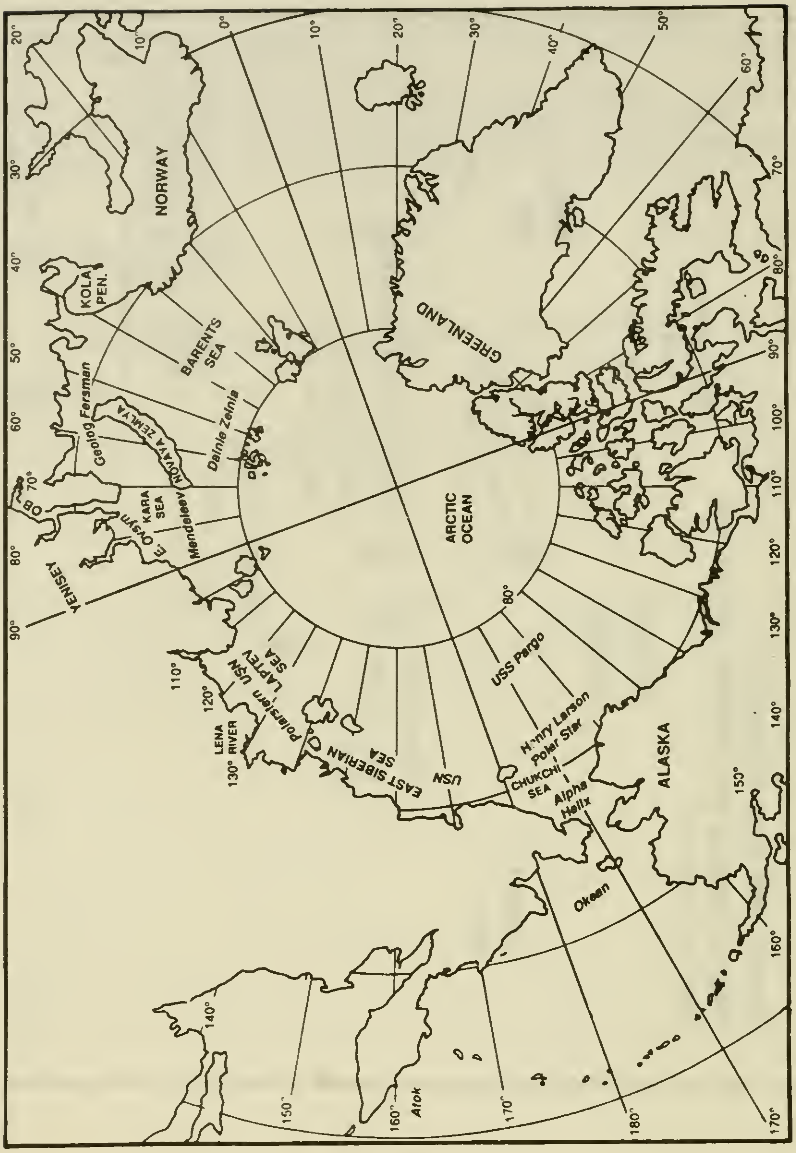
- Predict fate of contaminants if a release occurs
- Guide for selection of monitoring sites.



Reactor and Core Dumpsites
Fission Product and Actinide Estimates
Time of Disposal

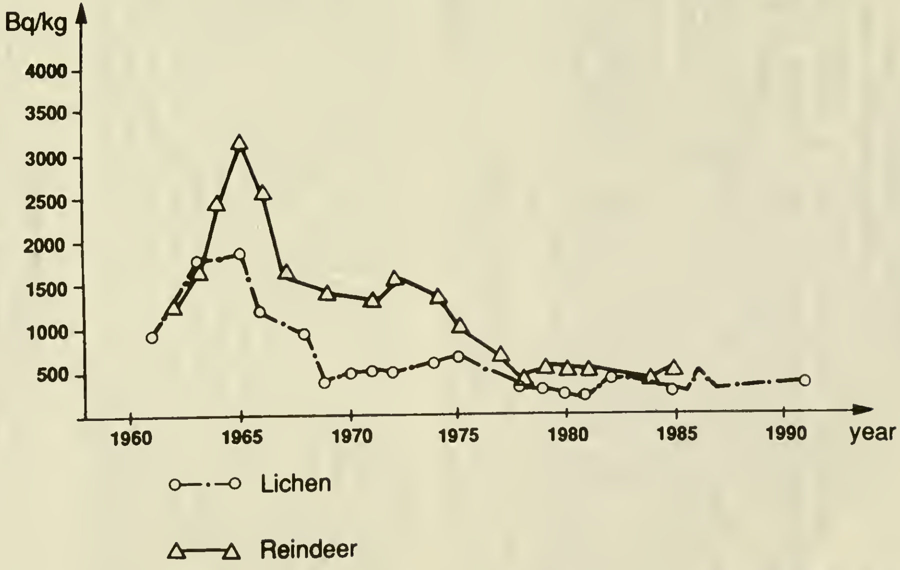
Estimates of Curie content based on calculations in Yablokov and Mount Reports. Does not include activated reactor components.

(FIG. 1)


NORWAY
KOLA PEN.
BARENTS SEA
Geolog Fersman
NOVAYA ZEMLYA
Dalnie Zelnia
KARA SEA
Mendeleev
E. Ovsym
OB
YENISEY
LAPTEV SEA
USN
Polarstern
LENA RIVER
EAST SIBERIAN SEA
USN
ARCTIC OCEAN
GREENLAND
USS Pargo
Henry Larson
Polar Star
CHUKCHI SEA
Alpha Helix
ALASKA
Okean
Alok
0°
10°
20°
30°
40°
50°
60°
70°
80°
90°
100°
110°
120°
130°
140°
150°
160°
170°
180°

(FIG. 2)

Average Values of Cs 137 Activity in Lichens and in Reindeer Muscle on the Kola Pen. 1960-1990



(From Matishov et al. 1992)

(FIG. 3)

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QUESTION FOR THE RECORD

QUESTION NUMBER 1

NAVY'S FUTURE ARCTIC RESEARCH PLAN

Question: What are the Navy's future plans and budget for Arctic research? for research directly related to the contamination issue? for the Arctic Monitoring and Assessment Program (AMAP)?

Dr. Johnson: The Navy's budget for research in the Arctic is about $15 million for basic and pollution-related research. The Office of Naval Research (ONR) is managing two one-year congressionally-mandated appropriations of $10 million each, to study the radionuclide contamination in the Arctic. ONR attempts to coordinate with the AMAP program, but does not have any funds specifically designated for this program.

QUESTION NUMBER 2

RUSSIAN FEDERATION RELEASE OF NUCLEAR DUMPING

Question: Do you think that the Russian Federation has released all relevant information that exists pertaining to its nuclear dumping in the Arctic?

Dr. Johnson: We believe that the Yablokov commission made a "good faith" attempt to document all the material that the Former Soviet Union (FSU) dumped in the Arctic, but it is unlikely that they were given all of the information on this subject. Nevertheless, we have so far obtained no information to suggest that the Yablokov commission's estimate of the total amount of radioactivity that was dumped is in serious error. It is clear that some of the positions for dump site locations given in the Yablokov report are off by up to several miles, but this could simply represent normal navigational errors.

QUESTION NUMBER 3

ARCTIC RESEARCH AND POLICY ACT

Question: With the knowledge that we have, do you think that there is a need to reevaluate the purposes and mandate of the Arctic Research and Policy Act?

Dr. Johnson: ONR has actively engaged in the Inter-agency Arctic Research Policy Committee (IARPC) activities mandated by the above-mentioned Act, and we believe that IARPC has led to improved inter-agency communication. Some of the mandated IARPC activities take quite a bit of effort, given the amount of funds available to support inter-agency research in the Arctic.

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QUESTION NUMBER 4

ONR BUDGET FOR RADIOACTIVE RESEARCH

Question: What is the budget for your individual agency for addressing radioactive contamination in the Arctic, particularly for the AMAP program?

Dr. Johnson: ONR has been asked by Congress to manage two one-year appropriations of $10 million each to study radioactive contamination in the Arctic. These monies have been supplemented by about $1 million from other ONR programs due to synergisms that exist between the programs. The Department of Energy (DOE) maintains several atmospheric monitoring sites in Alaska, and the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration, and the Department of Health and Human Services also do some monitoring.

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QUESTION NUMBER 5

NUCLEAR WASTE GENERATED BY RUSSIAN MILITARY

Question: Could you estimate how much nuclear waste the Russian military complexes generated in a year?

Answer: If "complexes" refer to nuclear submarine bases, the Office of Naval Intelligence (ONI) can provide rough estimates based on open source information in comparison to previous (outdated) methods employed by U.S. nuclear submarines. However, if "complexes" refers to civilian reactor radwaste generation, then DOE will have to respond. For the naval generated waste, Russian Naval officers have stated for the record that the Northern Fleet (overall) generates 8000-12000 cubic meters of liquid waste annually. Of this, approximately 80% is low level waste with volume activity less than 10 to the fifth BQ per liter. Annual production of solid waste by this fleet is 3000-4000 cubic meters. Combustible, pressible, metallic and other processible waste material reportedly constitute 75% of solid waste.

Reportedly, the annual volume of liquid radwaste generated for one reactor - 40-100 cubic meters. Most RS nuclear submarine have two reactors. During routine reactor refueling operations, 400-500 cubic meters of liquid waste are generated. Decontamination water (flushing the reactor with large volumes of water) constitutes the majority of this liquid waste.

We have no information which refutes these figures; in fact, they appear consistent with the U.S. Government's understanding of the Russian approach to naval radioactive waste management. (Note that these volumes are higher than U.S. experience. This may be a result of differences in design and the U.S. philosophy of minimizing waste creation.)

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QUESTION NUMBER 6

NUCLEAR WASTE DEPOSITS

Question: Please describe the amounts and locations of nuclear materials deposited (intentional and unintentional) by the U.S. Government into the ocean, and any assessment of threats of these materials to human health?

Dr. Johnson: These questions are best answered by DOE, EPA, and the Office of Navy Reactors. We have referred this question to these agencies. Meanwhile, ONR is unaware of any significant risks to human health posed by radioactive material placed in the ocean by the U.S, with the possible exception of localized areas in the South Pacific where nuclear weapons were tested before the cessation of atmospheric testing. The U.S. has deposited nuclear material in the oceans in the past and has lost two nuclear submarines, the *Thresher* and the *Scorpion*. The Navy's Office of Information recently released information on the disposition of these submarines, their nuclear reactors and weapons, and related environmental data.

QUESTION NUMBER 7

THREATS OF CONTAMINATION

Question: Please characterize the threats of contamination to the Arctic Ocean from the following sources: storage facilities and holding ponds around the Mayak and Chelyabinsk-65 military complexes, other sources within the Ob river watershed, and decommissioned vessels harbored in bordering areas.

Dr. Johnson: The Mayak and Chelyabinsk regions contain highly polluted sites. Estimates of anthropogenic radioactivity in these and other portions of the Ob watershed range upwards towards a billion Curies. The most polluted sites, however, are more far upstream from the Arctic Ocean, and there is no evidence of massive pollution entering the Arctic from the Ob or Yenesei rivers at the present time. ONR is, however, funding a "catastrophic release" study that will suggest if significant releases could occur, if, for example, a 100-year flood and a dam collapse co-occurred.

Decommissioned vessels harbored in bordering areas probably contain several million Curies of radiation. At present, there is no evidence of widespread releases from these sources, and the U.S. is hesitant about providing funds to decommission old nuclear submarines in the FSU because they are continuing to build new ones at a brisk pace. The U.S. side argues that the same technology used to build new subs could be used to decommission old ones.

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QUESTION NUMBER 8

RUSSIA'S REPROCESSING CAPABILITIES

Question: It has been reported that Russia will not have the reprocessing capacity to deal with the nuclear waste it generates until at least 1997. Is this accurate? what are the implications?

Answer: This information was provided in Yablokov's White Paper published in 1993 and was made under the assumption that money would be received and construction of a reprocessing facility would begin during the same year. If construction had commenced in 1993, completion might have been expected by 1997. However, this was not the case. Existing storage facilities in both fleet's reportedly are at capacity and have been for some time. The special liquids carrier PINEGA reportedly has limited liquid reprocessing capabilities; however, it appears this limited capability is not being utilized. Note: There is one PINEGA in each fleet that could be used. Cost, location, contract proposals, capacity and capability, management and what countries will contribute to this endeavor are all under negotiation at this time; therefore, it is doubtful that construction will begin anytime in the nearterm.

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QUESTION FOR THE RECORD
QUESTION NUMBER 9

INTEGRITY OF WASTE CONTAINERS AND REACTORS

Question: Can you describe what is known of the integrity of the waste containers and reactors which have been dumped in the Arctic? How high is the risk of significant leakage from these containers, especially considering the physical conditions which they are exposed to (including ice)? What is the likelihood of barrels and other wastes being transported by current and ice motions?

Dr. Johnson: The FSU dumped many thousands of containers of low and medium level wastes in the Arctic, typically in steel containers. Some of these containers are reported to have been fired on because they would not sink and others may have been damaged by pressure or corrosion. Nevertheless, there is no evidence of massive or widespread pollution from these sources, probably because the radionuclide levels in these containers were not too high to begin with. It is probable that many of these containers have already leaked, but any such leakage seems small compared to other signals, such as the radionuclides that reach the Kara Sea as a consequence of nuclear fuel reprocessing in Western Europe.

When the FSU dumped high level wastes (i.e., reactors with fuel still in them), they made significant efforts to contain the material. So far, there is no evidence of leakage from the high level wastes that were deposited in the Kara Sea region. By now, the original 2.3 million Curies of radioactivity in these wastes has decayed to about one million Curies (see appended report from Mr. Mark Mount of Lawrence Livermore National Laboratory). It should be noted that nuclear fuel reprocessing in western Europe has released approximately one million Curies of radioactivity into shallow marine waters.

The high level waste containers are not likely to be moved very far by ice motions or by currents. Barrels deposited in fjords or in waters deeper than 100 meters are also not likely to be transported very far. Barrels and other items deposited in open shallow water could be moved significant distances by ice. We note that most of the ice that leaves the Kara Sea would flow into the North Atlantic from the Arctic and most of this ice would melt over deep water. Movement of radionuclides that leave the containment vessel would depend on the radionuclide in question. Particle

QUESTION NUMBER 9 (cont.)

INTEGRITY OF WASTE CONTAINERS AND REACTORS

reactive radionuclides would be likely to be sequestered by local sediments and not move too far from the source region. More soluble radionuclides could be transported long distances, but mixing would dilute their concentrations greatly. Initial modeling supported by the ONR managed program suggest, for example, that a soluble radionuclide released in the Kara Sea should have its concentration reduced by at least four orders of magnitude before reaching Alaskan waters.

QUESTION NUMBER 10

WASTES DUMPED IN THE ARCTIC

Question: Could you please catalogue, from the information which has been provided to this point, the wastes which have been dumped in the Arctic (including amounts, locations, isotopes, and half-lifes)?

Dr. Johnson: This information is contained, to a large extent, in the Yablokov report and in the workshop reports, that in the aggregate are about the thickness of a telephone book. We have appended a brief U.S. Navy report (Survey of Information Published on Spent Nuclear Fuel Dumped in the Kara Sea by the Former Soviet Union) that summarizes what is known about high-level wastes that have been deposited in the Kara Sea, and the aforementioned report from Mr. Mark Mount that sheds light on the decay history of these wastes. We can provide a copy of the Yablokov commission report, if that is desired. In brief, liquid wastes have been dumped in the Barents and Kara Seas and thousands of containers containing low and perhaps medium-level wastes have been dumped at various locations in the Kara Sea and in fjords on the adjoining island of Novaya Zemlya. The total activity in these wastes is quite low compared to the 2.3 million Curies that were originally contained in the high-level wastes deposited in the Kara Sea Trough and in the fjords of Novaya Zemlya. The appended reports deal with the disposition of these high-level wastes which essentially represent nuclear fuel still contained in reactor vessels.

As noted above, the high-level wastes have probably decayed down to a value of about one million Curies. We have already noted that European reprocessing of nuclear fuel has released about one million Curies directly into shallow seas adjoining England, Ireland, and France.

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QUESTION NUMBER 11

NAVY'S POSITION ON NUCLEAR SUBMARINE ACCIDENTS

Question: It has been stated that, before the U.S. can pressure the Russian Federation to release further information concerning its nuclear submarine accidents, the U.S. should provide information about its own nuclear submarine accidents. What is the Navy's position on this point? Has all relevant environmental information pertaining to the Scorpion been made available to the international scientific community?

Dr. Johnson: The U.S. Navy has made all the relevant data on the *Scorpion* and *Thresher* submarine sinkings available to interested public and scientific communities, national and international.

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SEPTEMBER 30, 1993
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The information follows:

Every year the Director, Naval Nuclear Propulsion, provides as part of his Congressional testimony a public report titled Environmental Monitoring and Disposal of Radioactive Water from U.S. Naval Nuclear Powered Ships and their Support Facilities. This report, which is annually revised based on the latest data, includes a discussion of the environmental monitoring that has been conducted at the site of the sinking of USS SCORPION and USS THRESHER. The monitoring has shown that neither ship has had a significant impact on the radioactivity in the environment.

The applicable section from the February 1993 report is reproduced here:

"Two U.S. Naval nuclear powered submarines have been lost at sea in the Atlantic Ocean. The submarine THRESHER sank 10 April 1963, 200 miles southeast of Maine in water 8,500 feet deep. The submarine SCORPION sank between 21 and 27 May 1968, 400 miles southwest of the Azores in more than 10,000 feet of water. The reactors used in all U.S. Naval submarines and surface ships are designed to minimize potential hazards to the environment even under the most severe casualty conditions such as the actual sinking of the ship. First, the reactor core is so designed that it is physically impossible for it to explode like a bomb. Second, the reactor fuel elements are made of materials that are extremely corrosion resistant, even in sea water. The reactor core could remain submerged in sea water for centuries without releases of fission products while the radioactivity decays, since the protective cladding on the fuel elements corrodes only a few millionths of an inch per year. Thus, in the event of a serious accident where the reactor is completely submerged in sea water, the fuel elements will remain intact for an indefinite period of time, and the radioactive material contained in these fuel elements should not be released. The maximum rate of release and dispersal of the radioactivity in the ocean, even if the protective cladding on the fuel were destroyed, would be so low as to be insignificant.

"Radioactive material could be released from this type of reactor only if the fuel elements were actually to melt and in addition, the high-strength, all welded reactor system boundary were to rupture. The reactor's many protective devices and inherent self-regulating features are designed to prevent any melting of the fuel elements. Flooding of a reactor with sea water furnishes additional cooling for the fuel elements and so provides added protection against the release of radioactive fission products.

"Radiation measurements, water samples, bottom sediment samples and debris collected from the area where THRESHER sank were analyzed for radioactivity shortly after the sinking and again in 1965 by various laboratories. Similarly sea water and bottom sediment samples taken near SCORPION's hull were analyzed for radioactivity. In 1977, 1983 and 1986, follow up samples of water, sediment, marine life and debris were collected from the immediate THRESHER debris areas. In 1979 and 1986, follow up samples of water, sediment, marine life and debris were collected from the immediate SCORPION debris area. None of these samples showed any evidence or release of radioactivity from the reactor fuel elements in either THRESHER or SCORPION. However, cobalt 60 released from both THRESHER or SCORPION coolant systems was detectable at low levels in the sediment samples in the debris areas. The amount of cobalt 60 radioactivity in these samples was small compared to the naturally occurring radioactivity in the sediments. Based on the samples, less than 0.001 curie of cobalt 60 was estimated to be present in the sediment at either site. Cobalt 60 was not detectable in samples of water, marine life or debris. Thus, the THRESHER and SCORPION have not had a significant effect on the radioactivity in the environment. Additional information on the radiological surveys of the THRESHER and SCORPION debris areas is available in reference 22."

Reference 22 is the Final Environmental Impact Statement on the Disposal of Decommissioned, Defueled Naval Submarine Reactor Plants issued by the U.S. Navy in May 1984.

Additionally, subsequent to the Committee hearing and after several months of review within the Navy, Department of Defense, and other federal agencies, the Navy declassified the presence of two torpedoes with nuclear warheads aboard the SCORPION. Environmental monitoring described above found no evidence of plutonium release associated with those warheads. For reference, two reports were published under Navy auspices in October 1993 giving the detailed results of the monitoring summarized in the Navy report above. The reports are:

1. Deep Sea Radiological Environmental Monitoring Conducted at the Site of the Nuclear-Powered Submarine THRESHER Sinking; published by the Knolls Atomic Power Laboratory of the Department of Energy in October 1993.
2. Deep Sea Radiological Environmental Monitoring Conducted at the Site of the Nuclear-Powered Submarine SCORPION Sinking; published by the Knolls Atomic Power Laboratory of the Department of Energy in October 1993.

TESTIMONY OF DAVID A. COLSON
DEPUTY ASSISTANT SECRETARY OF STATE
FOR OCEANS AND FISHERIES AFFAIRS
BEFORE THE SUBCOMMITTEE ON OCEANOGRAPHY
OF THE COMMITTEE ON MERCHANT MARINE AND FISHERIES

September 30, 1993

Thank you for inviting me to testify before you today concerning radioactive contamination in the Arctic Ocean. I welcome this opportunity to exchange views and perspectives on what is a subject of growing concern to the United States, as well as to the international community.

It may be helpful to consider the Arctic Ocean as the central feature of a broader ecosystem. The Arctic region is comprised of a large ocean area, much of which is permanently ice covered, and is bordered by the United States, Canada, Greenland, Russia, and Norway. It is home to large populations of land and marine mammals and significant populations of fish. The Arctic also harbors important natural resources and is home to diverse indigenous peoples, who have lived there for thousands of years.

We have only a general understanding of water and ice currents in the Arctic Ocean. Also, potential sources, pathways, and migration of contaminants and their behavior under the Polar conditions of extreme cold are not well understood. The introduction of contaminants, such as radionuclides, into any part of the Arctic is a matter of concern to all Arctic nations and others who rely on its resources.

By way of background, I would like to briefly describe the domestic and international legal situation with regard to the deliberate disposal of radioactive wastes at sea. The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) is the primary international agreement controlling the deliberate disposal of wastes at sea. Since entering into force in 1975, the LC has demonstrated that it is one of the most successful of the marine pollution treaties to which the U.S. is a party, providing a structure by which the 71 parties have forged consistent progress in combatting marine pollution caused by dumping at sea.

The London Convention bans the dumping of high level radioactive waste at sea; the dumping of low level radioactive waste is subject to an LC moratorium, under a voluntary resolution adopted in the mid-1980's. All parties, including the U.S., have stated they are honoring this voluntary moratorium. Domestically, U.S. law prohibits the issuance of a permit for the disposal of low level waste unless certain designated findings have been made by the EPA Administrator and Congress adopts a joint resolution authorizing the ocean disposal. The U.S. has not dumped radioactive wastes at sea since 1970.

While the focus of my testimony today will be radioactivity in the Arctic caused by deliberate disposal or accidents at sea, it is important to place this topic in its larger context. The major sources of Arctic radioactivity of human origin are landbased sources, such as radionuclides from wastes dumped by atomic weapons facilities (such as Chelyabinsk) flowing into the Arctic from Siberian rivers and water runoff; airborne contamination, such as from fallout from atmospheric nuclear testing in the 1950's and 1960's and the 1986 Chernobyl incident; and natural sources.

The U.S. is participating in a broad range of fora to begin to identify, assess, and predict the environmental risks posed by the presence of radioactivity in the Arctic Ocean and northern Pacific Ocean. Of particular concern, however, is the Soviet dumping of radioactive wastes in the Kara and Barents Seas, the Sea of Japan, and the Sea of Okhotsk.

I would like to briefly review efforts by the United States to address this issue.

The task of the international community is to fill in important information gaps concerning radioactivity in the Arctic and, specifically, to assess, first, the extent and levels of radioactivity and, second, the possible consequences of past dumping of radioactive wastes by the former Soviet Union and, more recently, by Russia. Towards this end, the International Atomic Energy Agency (IAEA) and the parties to the London Convention obtained a Russian commitment last year to provide a report on past dumping by May, 1993. Honoring this commitment, Russia released the Yablokov Report on radioactive waste dumping in the Kara and Barents Seas and in the Sea of Japan and the Sea of Okhotsk, as well as information concerning the accident involving the Soviet nuclear submarine "Komsomolets." With the release of this report, the Russian Federation took an important first step towards providing basic information on the solid and liquid radioactive wastes dumped at sea from 1959 to 1992.

Nonetheless, major information gaps remain. For example, the known dump sites have not been thoroughly investigated and there has been little or no monitoring of major dump sites for much of the last 20 years. As a consequence, we do not know the extent or magnitude of the threat posed by them. Similarly, there is not the information on which to base a needed assessment of environmental risks and possible remedial actions. For this reason, the U.S. and other concerned states, such as Canada, Norway and Japan, have vigorously pursued the establishment of channels to obtain needed answers. Unfortunately, we have experienced problems regarding Russian clearance for planned research cruises last summer and this summer, delaying important work for another year.

According to the information provided officially by the Russian Federation, the radioactive material dumped in the Kara Sea by the former Soviet Union includes 17 nuclear submarine or icebreaker reactors: Six or seven of these reactors contain spent nuclear fuel and one shielding assembly from the icebreaker "Lenin" has only partially removed spent nuclear fuel. With one exception, the 17 reactors were dumped in the shallow fjords of the east coast of Novaya Zemlya; the exception, a reactor that contains fuel, was dumped in the Novaya Zemlya Depression about 40 miles off the coast at a depth of approximately 300 meters. The Yablokov Report claims that before dumping, reactor compartments were filled (except in one case) with a hardening mixture that should prevent spent nuclear fuel from coming into contact with seawater for several hundred years. Other solid radioactive wastes and some liquid wastes were also dumped in the Kara Sea, but most of the liquid wastes were discharged in the open Barents Sea in five defined areas. Among the radioactive wastes dumped, the greatest ecological hazard is presented by sunken objects containing spent nuclear fuel.

In addition to the amounts dumped in the Arctic, liquid radioactive wastes were dumped in the Sea of Japan and Sea of Okhotsk by the U.S.S.R. from 1966 to 1991 in five different areas. With respect to the Pacific, the largest volume of solid waste was dumped in the Sea of Japan, but the southeastern coast of the Kamchatka Penisula received the most radioactive low and intermediate level solid wastes. This material includes thousands of sunken containers, 38 sunken ships, and over 100 other objects, as well as two submarine reactors and one reactor assembly, all without spent fuel.

The Yablokov Report acknowledged for the first time that Soviet dumping of high level wastes constituted a violation of the London Convention and that the former Soviet Union had also made false representations to the LC and IAEA regarding the dumping of high level and low level radioactive wastes. The report also stated that the former Soviet Union had falsely stated it was honoring the London Convention's voluntary moratorium on the dumping of low level radioactive wastes. Russian suggestions that such dumping by Soviet or Russian sovereign immune vessels might not constitute a violation of the LC's ban have been unanimously rejected by other LC parties, and emphatically so by the United States. At the upcoming November 1993 annual meeting, LC parties are expected to continue their efforts of last year to encourage Russia to halt such dumping and to improve her cooperation with the international community, especially as involves access to known dump sites.

We remain concerned, however, that Russia is still dumping radioactive wastes at sea. The Yablokov Report identified existing and projected deficiencies in dealing with radioactive wastes resulting from the dismantling of decommissioned nuclear submarines and the handling of spent fuel, as well as a lack of adequate land facilities for the processing, storage, and disposal of radioactive wastes in general. The report concluded that constructing such facilities would require a minimum of five years, if an expedited construction program were adopted.

Since the release of the Yablokov Report, Russian officials have made ambiguous and sometimes contradictory statements concerning whether Russia is continuing to dispose of liquid or solid, or high or low level, radioactive wastes at sea. Minister of Environmental Protection and Natural Resources Viktor Danilov-Danilyan has at various times said that Russia has halted the dumping of liquid wastes at sea, but that limited or nonexistent land disposal and storage sites would not allow Russia to stop the dumping of solid wastes until at least 1996 or 1997. At the Kirkenes conference in August, Russian officials stated that Russia had not dumped solid wastes in 1993, but that Russia might be forced to resume such dumping in the future.

We will continue to urge Russia to halt any dumping of liquid or solid wastes, both through bilateral and multilateral channels, such as the IAEA and LC.

Looking towards low level wastes, we have just agreed with the other seven Arctic countries, including Russia, that we will "work and cooperate to provide, in the nearest possible future, conditions for a ban on all dumping of radioactive waste in Arctic waters, taking into account the revision of the London Convention."

We have also continued to urge Russia to cooperate more fully with international efforts to obtain information regarding past dumping and accidental contamination in the Arctic and northern Pacific. Despite various assurances to the contrary, there has been a continuing refusal by Russian authorities to allow direct access by international scientists to known dump sites.

Several research cruises involving the United States were planned for this summer, but serious problems arose at the last minute concerning access to the sites in question, even those well beyond the 12-mile Russian territorial sea. As a consequence, U.S. participation in the planned U.S./Russian "Mendeleev" cruise to the Kara Sea had to be cancelled in late August, although we understand that the cruise went forward without U.S. participation in early September. The second Norwegian/Russian/IAEA cruise narrowly escaped the same fate (this time, cancellation of Norwegian participation), when Russia refused permission for the vessel to visit one of the four long requested sites "solely for security reasons." In addition, foreign participants in the August/September Russian research cruise to the "Komsomolets" site 300 miles off the west coast of Norway were prohibited from active participation in the collection of samples. Dr. Hollister of the Woods Hole Oceanographic Institute, who will be testifying later this afternoon, was on this cruise and can provide fuller details of the problems he experienced.

Without international participation in such research activities and direct access by the international scientific community, questions will invariably be raised concerning the reliability of the data collected and any assessments based on such work. This, in turn, could have consequences for Russian requests for international assistance in connection with this issue. Thus, it would be in Russia's best interest to allow such international access.

The Russian Federation announced last week that it had concluded that it was necessary to seal some of the torpedo tubes of the "Komsomolets," even though the results from the most recent cruise have not yet been analyzed. The nuclear submarine "Komsomolets" sank off Bear Island, approximately 300 miles off the west coast of Norway, on April 7, 1989, following a fire and subsequent explosion. The Yablokov Report says that the upper part of the pressure hull in the area of the forward compartment is damaged and that the doors of the torpedo tubes are open and seawater is in contact with the torpedos and active warhead materials. I will leave a more complete description of what is known about this site to Dr. Hollister, except to comment again that the limited nature of the information concerning contamination and other conditions at this site and the absence of participation by foreign scientists in the collection and analysis of samples make an independent assessment of the need for such remedial measures premature.

We will continue to encourage international cooperation to obtain more complete information on which to base an assessment of the environmental impacts of past dumping activities.

Another matter complicating prioritization of assistance efforts by the international community concerning the Arctic radioactivity problem has been the number of research proposals and assistance requests received from public and private entities, often without indication of the Russian Government's official evaluation of the request.

Russia recently established several committees to oversee various aspects of radioactivity in the Arctic, including the Committee on Special Purpose Underwater Operations and the Committee on Environmental Security, which was created by President Yeltsin on July 12, 1993. In addition, Russia has suggested the establishment of an international fund for special underwater works and has invited the U.S. to attend a meeting in Moscow October 14-15 to discuss its creation.

The April 1993 G-7 Tokyo Summit recognized that ocean dumping of radioactive waste was "a matter of great concern" and that this issue "should be studied further." In July, U.S. representatives attended a G-7 "ad hoc" meeting of experts on radioactive waste dumping in the Arctic and northern Pacific, in an effort to improve avenues for bilateral and multilateral cooperation and coordination. The meeting, chaired by Japan, was attended by representatives from Norway, South Korea, and the EC Commission and included a frank exchange of information and views on Arctic radioactive contamination. At this meeting, the U.S. presented an overview of its current and planned activities, urging support for IAEA efforts and those of the Arctic Monitoring and Assessment Program, as well as enhanced information sharing among the participants. We anticipate that this new avenue of coordination will be continued.

The international community has aggressively sought to identify information gaps. The U.S. participated in the four important 1993 workshops on this issue, all of which included participation by Russian scientists and government representatives: One in Oslo; another in Anchorage; the third at Woods Hole Oceanographic Institute; and the most recent this August in Kirkenes, Norway. These workshops have served to clarify the present situation and have revealed more clearly what was indicated in the Yablokov Report: a lack of essential data on which to base an assessment of potential risks and uncertainty regarding site conditions and the effect of a polar environment, as well as the extensive pollution from landbased sources and airborne contamination.

Another means by which the international community has sought to identify and redress information gaps has been by work programs conducted through existing multilateral institutions, such as the IAEA. For example, in November 1992, Norway proposed a NATO/Committee on the Challenges of Modern Society pilot study on cross-border environmental problems emanating from defense-related installations and activities. The United States has been attending meetings on the pilot study for information purposes.

The United States also supports the IAEA's International

Arctic Seas Assessment Project, which grew out of the 1993 Oslo workshop involving the IAEA, Norway, and Russia. This project is being supported through voluntary contributions. The purpose of the study is to produce an independent, objective assessment of the potential radiological implications of the dumping in the Kara and Barents Seas and to address the question of possible remedial measures. At the same time, this project may provide a focus for reporting of national research and assessment work and a mechanism for encouraging international cooperation and collaboration. The IAEA is presently considering expanding the project to include the northern Pacific, if funding can be found. The U.S. made an extrabudgetary contribution of $35,000 in fiscal 1993 to support the existing IAEA project, and it is hoped contributions from other countries will follow in 1994 and 1995, to permit this ambitious effort to go forward.

The U.S. has also assisted the IAEA in a number of other ways, such as in analyzing core samples from the 1992 Norwegian/Russian/IAEA research cruise. The U.S. will soon provide a marine sediment geochemist to the IAEA's Marine Environment Laboratory in Monaco, in support of analysis of expected samples from the second Norwegian/Russian/IAEA cruise, now under way in the Kara Sea. The U.S. is also working with the IAEA on the development of its final report and inventory on accidents and losses at sea.

In addition, there is increasing cooperation among the eight Arctic nations on radioactive contamination, particularly through the Arctic Monitoring and Assessment Program (AMAP), under the Arctic Environmental Protection Strategy (AEPS). AMAP has identified radioactive pollution as a critical component to be monitored in the Arctic. At the Second Ministerial Meeting of AEPS, held in early September in Nuuk, Greenland, ministers agreed that:

1. Reliable, comprehensive systems be established to identify and characterize present and potential sources of Arctic contamination and to monitor levels of radioactive contamination;

2. Nuclear installations that may affect the Arctic meet international standards;

3. Actions be initiated to prevent further increases in man-made radionuclides, irrespective of the source, and to reduce contamination to the lowest achievable levels, taking economic and social factors into account; and

4. Clean-up programs be initiated for selected areas, as appropriate.

In an effort to coordinate the IAEA's project with the work of AMAP, it has been recommended that AMAP avail itself of the work initiated by IAEA. AMAP recently established a subgroup, under the chairmanship of Canada, to implement the radiological component of AMAP and to create such linkages to the research being conducted by other international institutions, such as the IAEA, NATO, and the Barents Sea Initiative.

In addition, the United States has various bilateral agreements with Russia that could be utilized for this purpose in connection with Arctic marine research on radioactive contamination. These include the 1989 Agreement on Cooperation in the Field of Basic Scientific Research, the 1990 Agreement on Cooperation in Ocean Studies, the 1972 Agreement on Cooperation in the Field of Environmental Protection, the Agreement on Mutual Fisheries Relations, and the 1990 Agreement on Peaceful Uses of Atomic Energy. A new Agreement on Scientific and Technical Cooperation is presently under negotiation with Russia.

U.S. agencies are engaged in cooperative work with Russian counterparts and experts, either bilaterally or through multilateral institutions. I will let individual agencies, such as the Department of Defense, EPA, NOAA, and the Department of Energy, describe their programs, except to note that $10 million in DOD funds is to be used to study radioactivity in the Arctic region. The Department of State (out of the OES special fund) has also provided funding for several research projects on Arctic contamination issues. U.S. Arctic research efforts are being coordinated by the Interagency Arctic Research Policy Committee.

The U.S. has contributed $25 million towards the establishment of the International Science and Technology Center in Moscow, to fund research involving former weapons scientists. The remaining $56 million is being furnished by the EC and Japan. The project has been delayed pending approval by the appropriate Russian authorities.

During the April 1993 Vancouver Summit, President Clinton and President Yeltsin announced their intention to expand and improve joint environmental protection work. President Clinton also announced three environmental related initiatives in the Vancouver package of assistance for Russia: Nuclear reactor safety, energy, and the environment. These initiatives will be expanded with funding from the $2.5 billion combined assistance package for the Newly Independent States (NIS), which Congress approved earlier this week.

The accelerated political, social, environmental, and economic changes taking place in the Arctic region, and important issues like this, suggest it is time to reevaluate current U.S. policy concerning the Arctic. In response to a

National Security Council directive, Arctic policy is now under review. We expect to place greater emphasis in our Arctic policy on environmental protection.

I thank the Subcommittee for the opportunity to present this testimony today.

QUESTIONS FOR THE RECORD SUBMITTED TO
DAVID A. COLSON
DEPUTY ASSISTANT SECRETARY OF STATE
FOR OCEANS AND FISHERIES AFFAIRS
BY THE SUBCOMMITTEE ON OCEANOGRAPHY
OF THE COMMITTEE ON MERCHANT MARINE AND FISHERIES

Questions and Answers

Question 1: Recent news articles have stated that the Russian Government has earmarked as much as $12.5 billion for new war ships. Much concern has arisen that the Russian Government seems to find plenty of funds for new construction while appealing to the world community for funds to clean up existing problems. Does the Administration have a policy which addresses this issue? What aid has the U.S. approved for the Russian Government to address environmental problems.

A: While the U.S. has no specific policy linking continued construction of war ships with assistance for nuclear waste clean-up, neither has the U.S. offered any such assistance. DoD funds were identified last year to monitor and assess radioactive waste contamination in the Arctic, but no money has been identified for actual clean-up. In FY-93 the USG allocated $12 million to the Environmental Project for the New Independent States (NIS). In the $2.5 billion assistance package which the Congress recently approved from the NIS, the USG has allocated $75 million for the Environmental Project, including a $15 million Aral Sea program.

Question 2: Could you describe how U.S. bilateral and multilateral Russian aid is coordinated with Arctic environmental protection efforts and how the State Department is involved?

A: The Office of Naval Research (ONR) received $10 million in FY-93 Nunn-Lugar funds to study Arctic radiological contamination. The study focuses on sources of contamination and models on the release and transport of radionuclides.

The State Department's Oceans, Environment and Science office funded Arctic projects totaling $828,500 in fiscal year 1993. The State Department provided funds to the International Secretariat of the Arctic Monitoring and Assessment Program; funded an expedition aboard a Russian vessel to study the biogeochemical cycles of contaminants; and, along with EPA, funded a conference on Arctic airborne contaminants. In support of the Arctic Environment Protection Strategy, an Arctic Environmental Atlas was commissioned which will present areas most likely to be affected by ozone depletion and climate change and will document environmental disasters in the Arctic.

Question 3. Is the State Department currently working on agreements which will allow access to some of the more important Arctic dumping sites?

A: We are urging Russia to grant enhanced access by the international scientific community to important dump sites in the Kara and Barents Seas and also in the Sea of Japan and Sea of Okhotsk. Most of these dump sites are within the internal waters of Russia or Russia's 12-mile territorial sea; the others are within Russia's 200-mile Exclusive Economic Zone. We believe it is important that there is international participation in research efforts concerning such dump sites and the Komsomolets accident site 300 miles off the coast of Norway. We therefore are encouraging such participation by international organizations such as the IAEA and bilateral or multilateral research efforts, such as the Norwegian/Russian cruises and the proposed Japanese/Russian cruise. We do not necessarily seek direct U.S. participation, unless welcomed by Russia.

We are conducting discussions with Russia concerning this issue, in our continuing effort to assess the degree of environmental risk from prior radioactive waste dumping. We are coordinating these efforts with the other most directly concerned states bilaterally and through the G-7 "ad hoc" experts group plus Norway and South Korea, the IAEA, the LC, and AMAP.

Question 4: What are the obligations of the Russian Federation with respect to radioactive waste dumping in the Arctic under the London Convention and under international environmental law?

A: The U.S.S.R. was a party to the LC on the date it became effective: August 30, 1975. From that date, all parties were prohibited under Article IV(1)(a) from dumping high level radioactive wastes at sea. According to the Yablokov Report, such Soviet dumping occurred after this date from 1975 to 1991. It is unclear whether such wastes were also dumped by Russia in 1992; Russia has stated that it did not dump high level wastes in 1993.

The U.S.S.R. was also required under Article IV(1)(b) and (2) to issue an advance special permit prior to dumping any low level radioactive wastes and to comply with the requirements of Annex III concerning the criteria to be applied in considering whether to issue such a permit (characteristics and composition of the matter, characteristics of the dump site and method of deposit, and general considerations and conditions). In addition, the LC requires that notice of the dumping of low level radioactive wastes must be given to the IMO, as

Secretariat to the LC. This was not done by the U.S.S.R., which stated such dumping had not occurred in response to specific questionnaires from the IMO. Russia gave notice to the IMO on October 20, 1993, with respect to the October 16-17, 1993, dumping of 900 cubic meters of liquid wastes in the Sea of Japan. There is no requirement in the LC that such notice be given in advance of the dumping.

Since 1983, various resolutions have been adopted by the LC to establish a moratorium on the dumping of low level radioactive wastes. Contracting parties have stated they were honoring this moratorium, although such resolutions are not binding. After the issuance of the Yablokov Report in March 1993, Russian officials began making ambiguous and qualified statements about whether Russia would continue to honor this moratorium and also regarding Russia's obligations concerning high level wastes. The U.S. has urged Russia to honor its treaty obligations with respect to high and low level wastes and to abide by the moratorium. We will continue to do so through bilateral and multilateral channels.

International environmental law is a rapidly evolving and is not codified in any single source. Certain rules of international law including inter alia, those with respect to transboundary harm, may be applicable once we learn more about the extent of environmental damage caused by such activities. It should also be noted, that Article 197 of UNCLOS, which is respected by many nations, including the USG provides:

> States shall co-operate on a global and, as appropriate, on a regional basis, directly or through competent international organizations, in formulating and elaborating international rules, standards and recommended practices and procedures consistent with this Convention, for the protection and preservation of the marine environment, taking into account characteristic regional features. (Art. 197)

Question 5: With the knowledge that we have, do you think that there is a need to reevaluate the purposes and mandates of the Arctic Research and Policy Act?

A: From a State Department point of view, and according to others in the "Arctic community," the Arctic Research and Policy Act (ARPA) does not need revising, rather, it should be more fully implemented. With the review of U.S. Arctic policy now before the National Security Council, (submitted Tuesday, November 2), the best way to move forward with the Arctic Strategy is through the recommendations made in the review. The policy review addresses the adequacy of the Act in detail and concludes that Executive Branch implementation could be improved through additional interagency focus, similar to the process that produced the joint research plan on Arctic contamination. The realization of the ARPA requirement for a Federal-wide Arctic research budget would also be useful. The National Science Foundation is the lead agency on the Arctic Research and Policy Act and may have more on the question of reevaluating the Act.

Question 6: In concluding your testimony, you stated that the National Security Council has issued a directive to review U.S. Arctic policy. When will this review be completed?

The U.S. Arctic Policy Review was submitted to the National Security Council on November 2, 1993, with the approval of all key agencies.

Question 7:

The Yablokov Report outlines some blatant and relatively recent violations of international law by the former Soviet Union. How was the report received within the current Russian scientific and military communities?

A:- The Yablokov Report recognized for the first time that the U.S.S.R. had dumped high level radioactive wastes in violation of its treaty obligations under the LC and of domestic law. This report, which was made public, was not viewed with the same concern in Russia as it was by other concerned states. In large part, this was due to the fact that radioactive contamination on land and in rivers and estuaries and the potential risks posed by outmoded nuclear facilities are by far the greater and more immediate threat to human health and safety in Russia.

The Russian scientific community is also aware that the major sources of radioactive pollution in the Arctic are from air and land-based sources (such as run-off) and from natural sources, rather than from dumping at sea. However, as Russian awareness of international concern grew, so did calls for immediate funding of various Russian institutes and scientists for a broad range of projects.

Russian military officials on occasion have sought to justify the dumping operations described in the Yablokov Report as not being a violation of the LC because conducted by sovereign immune vessels of the Russian Navy. That rationale is rejected by the United States and all other LC parties, as was made clear to Russia in the July LC Amendments Conference. The U.S. has urged Russia to honor its treaty obligations with respect to high and low level wastes and to abide by the moratorium. We will continue to do so through bilateral and multilateral channels.

STATEMENT
OF
DR. NED A. OSTENSO
ASSISTANT ADMINISTRATOR
OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

BEFORE THE
SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO
AND THE OUTER CONTINENTAL SHELF
MERCHANT MARINE AND FISHERIES COMMITTEE
U.S. HOUSE OF REPRESENTATIVES

SEPTEMBER 30, 1993

Mr. Chairman and Members of the Subcommittee:

I welcome the opportunity to testify at this hearing on the topic of potential radioactive contamination of the Arctic. This topic began to surface about two years ago when allegations of past practices of the former Soviet Union (FSU) in disposing of radioactive wastes began to be raised. The possibility of radioactive contamination of the Arctic concerns the National Oceanic and Atmospheric Administration (NOAA) because of the time scales associated with radionuclides, and because of the responsibility of NOAA for global environmental stewardship, and particularly marine resources. We recognized that if the problem was real then it had to be understood so that the United States would have scientifically credible information upon which to base policy and decision making. Research, which I will discuss further, would also allow us to address public perceptions that potentially could affect markets for various products, posing socioeconomic consequences for the United States, especially Alaska, and for other nations.

INTRODUCTION

NOAA long has recognized the enormous economic and strategic importance of the Arctic. More than 50 percent of the U.S. continental shelf and coastline resides with Alaska, much of it in the Arctic. The Arctic contains some of the richest mineral, energy, and biological resources on Earth. For example, the U.S. pollock fishery in the Gulf of Alaska and Bering Sea is a $2 billion industry. NOAA is concerned that the living and nonliving resources of this part of the globe increasingly are threatened by pollution.

The Arctic is a critical component of the global environment; it not only is an excellent barometer of global change, it also is a "forcing function" of global change. Unfortunately, knowledge of the processes at work in the Arctic, and of the effects of the industrial activities of the northern hemisphere, is immature at best. Any assessment of the risks posed by radioactive contamination of the Arctic ecosystem thus would be constrained by these significant uncertainties.

During the last two years, NOAA has contributed to the understanding of radioactivity in the Arctic through involvement with the Interagency Arctic Research Policy Committee (IARPC), the Arctic Monitoring and Assessment Program (AMAP), and other fora. Discussions have addressed the potential contamination of the Arctic by radionuclide disposal by the FSU as well as that of other nations. They also have addressed contamination of the Arctic by other toxic substances such as persistent organic compounds and heavy metals. These latter contaminants could pose a greater risk to Arctic ecosystems and human health than that from radionuclide contamination. This testimony, however, focuses on contamination by radionuclides.

The concern over radioactive contamination of the Arctic primarily derives from the reported accidental and intentional dumping or discharge of radioactive materials and wastes by the FSU. The Yablokov Commission Report, prepared at the request of Russian Federation President Boris Yeltsin, identified that the FSU dumped, in violation of international law, or lost in the marine environment, radionuclide material totaling more than 2,500,000 curies of radioactivity. This figure does not include radioactivity released from nuclear testing. Most of the radioactive material associated with the stated level of activity has been disposed of in the Arctic. The quantity of dumped materials represents twice that disposed into the Atlantic and Pacific Oceans by all other nations combined. Included in this total are liquid radioactive waste, sealed barrels of solid radioactive waste, fueled nuclear submarines, and more than one dozen intact nuclear reactors. Solid fuel wastes, totalling another 10,000,000 curies of radioactivity, currently are stored on vessels in Murmansk harbor awaiting development of disposal sites. This reported accounting of radioactivity in the Arctic does not include radioactivity that may exist in the FSU's vast terrestrial watersheds, river systems, and tundra, which may eventually find its way to the Arctic Ocean. It also does not include the reported FSU radioactive waste sites in the northwestern Pacific Ocean. These sites are a subject of concern because of the potential for transport through the Bering Strait into the Arctic Ocean.

The FSU is not the only party believed to be responsible for the presence of radionuclides in the Arctic Ocean. For example, research results from the recent Woods Hole Oceanographic Institution conference on radioactivity in the Arctic Ocean confirm that radioactive discharges originating from Sellafield, United Kingdom, and Cap La Hague, France, are entering the Barents Sea.

The reports of radioactivity in the Arctic Ocean need to be verified as to actual locations of sources, source strengths, and types of radionuclides present. Methodologies that have been used by the Russians to measure radioactivity, as well as quality control procedures, also need scrutiny. However, presently available data suggest that potentially significant adverse ecological effects may occur if the estimated concentrations of contaminants were to become bioavailable.

In order better to understand this situation, it is clear that an interdisciplinary assessment, involving other Arctic rim countries, should be conducted. The Arctic radioactive studies now being conducted through the Department of Defense, under the program management of the Office of Naval Research, should provide preliminary findings on any potential imminent threat. NOAA is participating in these studies on a cooperative basis by collecting and analyzing sediment and biological samples, including tissue samples from species used in native subsistence, in order to help determine the present amount and source of radionuclides in the U.S. Arctic. In the long-term, decomposing containers and reactors also are a significant source of concern. This concern can only be addressed through a long-term environmental assessment and monitoring program. Such a program should include marine sediments, ice, water, and biota.

NOAA is working with the IARPC to formulate an interagency plan to assess the potential long-term problem so that recommendations can be made upon which to base policy and decision making.

THE IARPC ROLE

The Arctic Research and Policy Act of 1984 calls for a "comprehensive national policy and program plan to organize and fund currently neglected scientific research with respect to the

Arctic." It also established the Arctic Research Commission (ARC) and the Interagency Arctic Research Policy Committee (IARPC). The role of the ARC is to provide policy guidance for establishing and implementing a national Arctic research program. The role of the IARPC is to work with the ARC to establish an integrated national Arctic research program, and to develop and implement, under current budget constraints, a 5-year national research plan that would be updated biennially. The IARPC is chaired by the Director of the National Science Foundation; senior representatives of most federal agencies participate in the IARPC.

The IARPC has agreed to a Policy Statement and Agenda for Action on Arctic Contamination. In doing so, the IARPC has assumed the lead U.S. role in clarifying the overall Arctic contamination issue. The need for such clarification was apparent at the IARPC's Workshop on Arctic Contamination that was held in Anchorage, May 2-7, 1993. Although much scientific information was presented relating to the Arctic environment and the potential problem of contamination of the Arctic, the Workshop indicated that a dearth of credible scientific information existed upon which to make conclusions and policy, particularly regarding long-term scenarios.

Because of this lack of information, the IARPC is drafting a plan, the overall goal of which is to assess the sources, transport, fate, effects, and risks of contaminants directly dumped in, or being transported to, the Arctic. The planned approach involves data rescue and synthesis, observations, process-oriented research, model development, impacts analysis and determination of risk, and information management.

THE NOAA ROLE

The Arctic plays a unique role in the balance of the Earth's systems. Thus, NOAA puts a high importance on developing a better understanding of this region. Key programs that NOAA administers that have a bearing on understanding the potential contamination of the Arctic include:

Marine Mammal Tissue Archive
National Status and Trends Program
Climate Monitoring and Diagnostics Laboratory at Barrow
Polar Satellites
Arctic Ocean Circulation Studies
Arctic Air Transport Studies
Geophysical Fluid Dynamics Laboratory Modelling Efforts
NOAA/Navy Joint Ice Center
Data Rescue Efforts

At a recent NOAA-hosted meeting in Seattle of the U.S.-Russian Joint Committee on Cooperation in Ocean Studies, U.S. and Russian officials exchanged information and viewpoints on radionuclide pollution of the oceans. Representatives of both governments stressed the importance of cooperation and coordination between agencies of our two governments on this topic. There was also a discussion of the need to develop comparable standards for measuring low-level radioactivity in the marine environment. It was agreed that scientists in the National Institute of Standards and Technology will work with Russian scientists in developing such standards.

NOAA also has been involved with the Department of State in the deliberations that led to the Arctic Environmental Protection Strategy (AEPS), and with the associated Arctic Monitoring and Assessment Program (AMAP), where NOAA is Co-Chair with the Environmental Protection Agency for the United States' involvement. The AEPS is a signed, although legally non-binding, international declaration established by the eight Arctic-rim nations (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the United States) to understand and protect the Arctic from contamination. The associated AMAP's purpose is to measure the levels of anthropogenic pollutants and to assess the effects of pollutants on the marine environment. One of the three primary goals of AMAP is to measure and assess radionuclides in the Arctic, and the AEPS nations have expressed grave concern about possible radioactive contamination in the region. I believe that an assessment by the United States of the radioactivity in the Arctic is quite fitting with the United States' responsibilities under both the AEPS and AMAP.

At the September 16, 1993 Meeting of Ministers of the AEPS, the Ministers agreed to ensure that no disposal of radioactive waste or material will be made in Arctic waters in violation of provisions of the London Convention (1972). They agreed to "work and cooperate to provide, in the nearest possible future, conditions for a ban on all dumping of radioactive waste in Arctic waters, taking into account the revision of the London Convention."

The Ministers also agreed to ensure that nuclear installations that may affect the Arctic meet international nuclear and radiological safety standards established by the International Atomic Energy Agency (IAEA). Additionally, the Ministers agreed to initiate action to prevent further increases in radionuclide levels and to initiate clean-up programs, as appropriate.

CONCLUDING REMARKS

In concluusion, NOAA supports the approach of a coordinated interagency assessment of the potential contamination of the Arctic by radionuclides as well as other contaminants. I believe that NOAA can best fulfill its responsibilities in this respect by continuing to work with the Interagency Arctic Research Policy Committee to help define an appropriate response strategy.

Mr. Chairman, this completes my prepared statement. I will be pleased to answer any questions.

FOLLOW-UP QUESTIONS FOR DR. NED OSTENSO
BEFORE THE SUBCOMMITTEE ON OCEANOGRAPHY,
GULF OF MEXICO AND THE OUTER CONTINENTAL SHELF
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES
SEPTEMBER 30, 1993

QUESTION 1: Do you think that the Russian Federation has released all relevant information that exists pertaining to its nuclear dumping in the Arctic?

ANSWER: The "Yablokov Report" was called for by Russian Federation President Yeltsin in Decree No. 613 of October 24, 1992. The report, which was released in the spring of 1993, is the most comprehensive document that I have read regarding the dumping and release of radioactive waste to the Arctic and other seas of the far western Pacific. Furthermore, it openly admits to illegal dumping by the former Soviet Union under the London Dumping Convention as well as the lack of reporting of these illegal activities to the International Atomic Energy Agency.

My assessment of whether or not the Yablokov Report represents an "all inclusive" accounting of the radioactivity that the former Soviet Union has released to the Arctic would be pure conjecture.

QUESTION 2. With the new knowledge that we have, do you think that there is a need to reevaluate the purposes and mandates of the Arctic Research and Policy Act?

ANSWER: I think that the purposes and mandates of the Arctic Research and Policy Act are basically sound and flexible. However, there has been a need to reevaluate Arctic policy in light of the changing national defense situation, environmental protection of the Arctic, and the relationship of the Arctic to the question of climate and global change. The Clinton Administration has required this as part of an Arctic Policy Review pursuant to PRD/NSC-12, which has been prepared by various agencies working with the Department of State as the lead agency. This document was to be transmitted to the National Security Council on October 29, 1993, unless serious objection on policy grounds was expressed by any of the reviewing Federal agencies.

QUESTION 3. What is NOAA's role in the National Security Council's review of U.S. Arctic policy?

ANSWER: NOAA's role in the National Security Council's review of U.S. Arctic policy, the PRD/NSC-12 directive referred to in Question 2, has been extensive from the very beginning, from providing material to helping develop the first draft. NOAA has attended all the discussions related to the review, and provided comment on the various drafts. This has involved several NOAA offices, including the one for which I am the Assistant Administrator, Oceanic and Atmospheric Research.

QUESTION 4. What are NOAA's future plans and budget for Arctic research? for research directly related to the contamination issue? for the AMAP program?

ANSWER: As I mentioned in my testimony, NOAA has a broad range of responsibilities that can be summarized in four categories: observations, monitoring, understanding, and predicting. The associated activities, including modeling and prediction, address natural resources, transport pathways, contamination, natural hazards, and climate and global change. NOAA's current budget for these activities is about $13 million as reported in the Spring 1992 volume of Arctic Research of the United States, issued by the Interagency Arctic Research Policy Committee. NOAA's plans for future Arctic research are dependent upon the Administration's priorities.

NOAA is participating in the Office of Naval Research (ONR) studies of radioactive contamination of the Arctic by: (1) providing a member to the science advisory board for these studies, and (2) investigating the level of radionuclides in certain marine biota and sediments. The latter effort is funded by ONR to collect and analyze sediments and biological samples, including tissue samples from species used in native subsistence, in order to determine the amount and source of radionuclides in the U.S. Arctic. It is hoped that these studies can be expanded and built upon in the future.

NOAA, working with the Department of State and with the Interagency Arctic Research Policy Committee (IARPC), is assuming a lead role for contributing to the U.S.' participation in the Arctic Monitoring and Assessment Project (AMAP). This includes providing data that NOAA has or is presently collecting in the Arctic that is of relevance to the AMAP effort. It also includes providing a Head for the U.S. Delegations to the AMAP Task Force meetings that are working to further refine the AMAP program and to ensure it meets the goal of defining the health of the Arctic environment.

Testimony of Bruce F. Molnia, Ph.D.
U.S. Geological Survey
House Committee on Merchant Marine and Fisheries
Subcommittee on Oceanography, Gulf of Mexico,
and the Outer Continental Shelf
September 30, 1993 Hearing
Radioactive Contamination in the Arctic Ocean

Mr. Chairman and members of the Subcommittee:

From May 2 to 7, 1993 the Interagency Arctic Research Policy Committee (IARPC) conducted a Workshop on Arctic Contamination, held in Anchorage, Alaska. The Workshop evaluated the issues of contamination from radionuclides, as well as trace metals, persistent organic compounds, and hydrocarbons. The Workshop was attended by more than 250 participants from the U.S, Canada, the Russian Federation, Norway, the European Economic Community, Finland, Great Britain, and the International Atomic Energy Agency. Twenty five Russian scientists and government representatives prepared presentations for the Workshop.

The goal of the Workshop was to provide U.S. Government decision makers with a factual basis for formulating U.S. policy on Arctic contamination. To reach this goal, the Workshop attempted to: identify sources of existing data and information about Arctic contamination; identify the breadth of existing data and information about Arctic contamination; identify major data gaps that need to be filled to complete a thorough analysis of the Arctic contamination question; and begin the process of determining whether specific Arctic contaminants present a risk to the environment, ecosystems, or human health in: Alaska, the entire Arctic, or the global environment.

A principal focus of the Workshop was to understand the disposal of radionuclide wastes by the former Soviet Union (FSU). This was done with the full cooperation of the government of the Russian Federation. In a letter of welcome and cooperation, Russian Federation Ambassador V. Lukin states that: "Russia has been taking and will take the necessary measures in the interest of monitoring and stabilizing the ecological situation in the northern and far-eastern seas. ...there is a strong understanding in Russia that global recognition of this problem is a natural basis for expanding the mutually beneficial cooperation in this field with all concerned countries."

V. Lystsov (Russian Federation, Ministry of Environmental Protection), presented a summary of the Yablokov Commission report, Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territory of the Russian Federation, prepared for President Boris Yeltsin. The report describes the dumping, disposal, and loss of: liquid and solid radionuclide wastes, nuclear submarines, and fueled and unfueled submarine and icebreaker reactors in the Arctic Ocean's marginal seas. The report identifies that more than 2 million Curies of radionuclide wastes were dumped into the Kara and Barents Seas alone. The report also identifies that radionuclide wastes were dumped into the northwesternmost Pacific Ocean, the Sea of Okhotsk, and the Sea of Japan, as well as into Russian rivers which drain into the Arctic Ocean. Workshop participants presented detailed information about radioactive and toxic wastes that were dumped from FSU nuclear facilities into adjacent rivers and lakes. Chronic problems were described at some of these facilities, including the continuing leakage of waste. Observed concentrations of both trace metals and organic contaminants in western and central Siberian rivers, especially the Ob, Lena, and Yenisey, substantially exceed the maximum limits of Russian Federation law. Little information is available about the eastern Siberian rivers or the disposal of radionuclide material into the Laptev, East Siberian, and Chukchi Seas.

At the time of the Workshop, virtually no information existed about the status of radionuclide waste materials dumped at any of the FSU's marine dump sites. Most sites have not been investigated in more than 25 years. Kara and Barents Sea samples collected at locations substantially distant from the dump sites do not show elevated levels of radioactivity, suggesting that to date, no significant movement has occurred.

Not all radioactive contamination results from human activities. One Russian presentation identified that in some Siberian oil and gas production areas, permafrost processes concentrate natural radioactivity in brines, resulting in radiation levels up to an order of magnitude above maximum acceptable levels.

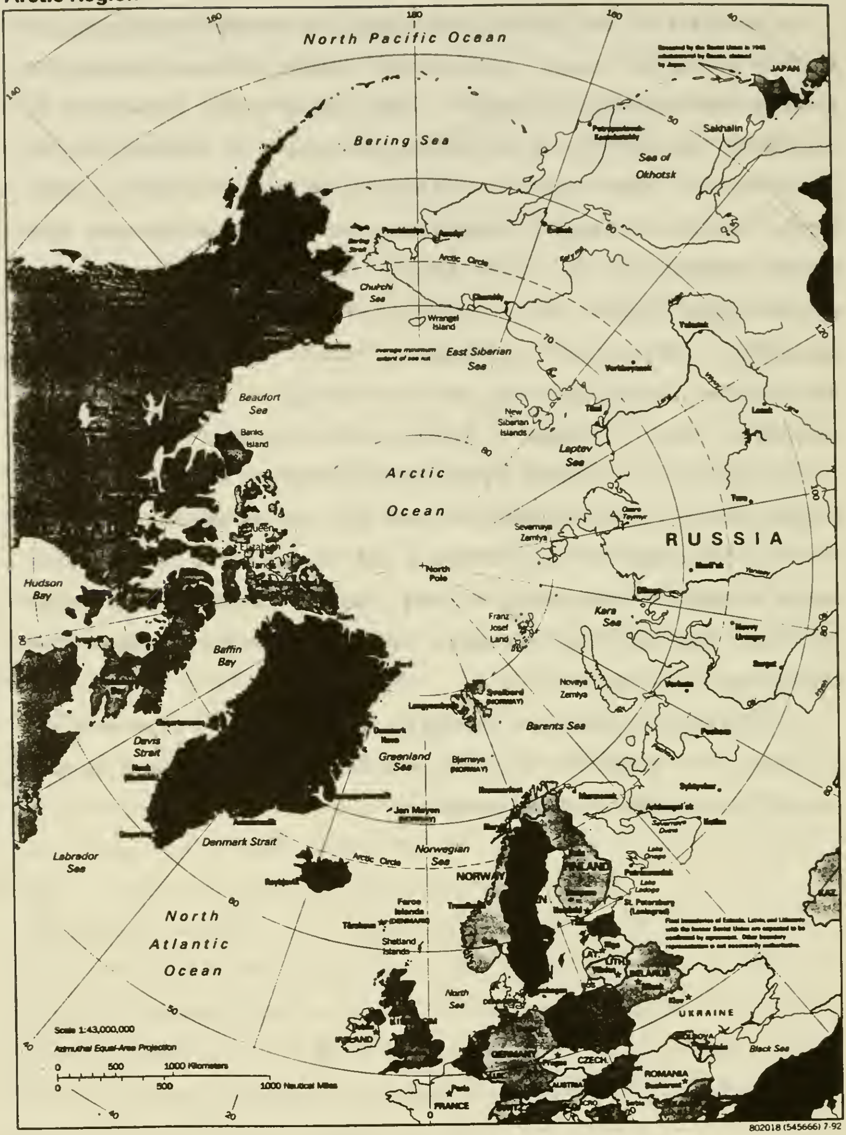
Workshop presentations also confirmed that not all Arctic contamination is the result of the activities of the FSU. Presentations identified sources of radionuclide contamination from beyond the Arctic, including radioactivity entering the Barents Sea from nuclear fuel reprocessing plants in NW Europe. Waste disposal sites were identified in Alaska as well.

An analysis of the information presented at the Workshop shows that on a regional basis, there is not enough credible scientific information available to conduct a comprehensive risk assessment to determine the effects of Arctic contamination on ecosystems and human health. The magnitude of the long-term risk resulting from Arctic dumping to aquatic ecosystems, terrestrial ecosystems, and human populations in the Arctic and beyond is unknown. Surprisingly, there is a general absence of systematically collected scientific information about contaminant type, distribution, transportation, and fate throughout the Arctic and no systematic program exists to monitor U.S. - Alaskan waters.

One report of a highly radioactive piece of metal found on a Novaya Zemlya beach suggests that sea ice may be impacting dumped materials and may be redistributing and transporting radionuclide waste materials from their initial disposal sites. Materials, including contaminants, entrained in sea ice can be transported throughout the entire Arctic.

I would be very happy to expand on anything that I have said or to answer any questions that you may have. A sketch map of the Arctic is attached to this testimony.

Arctic Region



United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA 22092

In Reply Refer To:
Mail Stop 917
#930578

JAN 3 1994

Honorable Solomon P. Ortiz, Chairman
Subcommittee on Oceanography, Gulf of
Mexico, and the Outer Continental Shelf
Committee on Merchant Marine and Fisheries
U.S. House of Representatives
Washington, D.C. 20515-6230

Dear Mr. Chairman:

Thank you for your letter of October 12, 1993, submitting to Bruce Molnia questions for written responses which will be included in the record of the hearing on nuclear contamination in the Arctic Ocean at which Dr. Molnia testified on September 30, 1993.

We welcome the opportunity to assist you and the members of the Subcommittee on Oceanography, Gulf of Mexico, and the Outer Continental Shelf in the effort to gather information on the extent of radionuclide contamination in the Arctic Ocean.

Enclosed are responses to the questions submitted. If we can provide you with any additional information or assistance, please let us know.

Sincerely yours,

/S/ ROBERT M. HIRSCH

Robert M. Hirsch
Acting Director

Enclosure

Responses to Questions Submitted to Bruce F. Molnia

Question 1: How was the Yablokov Commission Report received within the current Russian scientific and military communities?

Response: In general, the response of the Russian scientific community to the Report has been very positive, but little is known about the response of the military community. Since the release of the Report in late March 1993, Dr. Molnia has interacted with more than 50 members of the Russian scientific community who are familiar with some, if not all, of the details of the Report. These individuals (who represent government ministries, Academy institutes, and several universities) have, without exception, expressed surprise and concern about the extent of contamination and the potential ecological risk and environmental consequences that could result from the dumped materials and dumping activities described in the Report.

Most of the Russian scientists with whom Dr. Molnia spoke had not had an opportunity to see the Report in its entirety. Several indicated they were members of environmental organizations and very proudly identified themselves as concerned scientists and citizens. They expressed a willingness to help whenever possible to document information not detailed or presented in the Report.

Question 2: Can you describe what is known of the integrity of the waste containers and reactors which have been dumped?

Response: In general, virtually nothing is known about the integrity of the waste containers and the integrity of the reactors which have been dumped in the Kara Sea and elsewhere. To our knowledge, not a single container has been recovered from any of the Russian dump sites, consequently, none have been examined by U.S. investigators. A Russian cruise in September and October 1993, attempted to investigate several of the dump sites. At one site, side-scan sonar was used to delineate the sunken barge which had transported the waste containers to the Nova Zemlya Deep, a marine disposal site about 100 km east of Nova Zemlya. Attempts to use underwater television to ascertain the integrity of the waste containers failed due to problems with the television system.

Similarly, it is our understanding that virtually nothing has been learned about the reactors. The Yablokov Report identifies that most reactors were prepared prior to disposal with a fill of an organic polymer made from oak husks. We are unaware of any recent information about the reactor's integrity.

Question 3: How high is the risk of significant leakage from these containers, especially considering the physical conditions to which they are exposed (including ice)?

Response: It is our opinion that there is a very high probability (risk) that the Russian waste containers will eventually leak. As no information exists about the status of these drums, it is possible that some may already have had their integrity compromised. This opinion is based on our own experience with our own dumped nuclear wastes. In the 1946-1962 period, the United States dumped more than 75,000 drums of radioactive waste in the vicinity of the Farallon Islands, west of San Francisco, California. Surveys of these drums, conducted between 1974 and 1977, show that some had imploded and that corrosion was present on most, if not all of them. Studies reported by Robert Dyer (U.S. Environmental Protection Agency) at the IARPC Workshop showed that in the Farallon Islands area, 34 years of corrosion would create a 50 percent reduction in wall thickness of a standard 1.33 mm thick 55 gallon drum exposed to seawater. In the Arctic, seawater has a higher oxygen content than offshore California. Consequently, the rate of corrosion in the Kara and Barents Seas may be even higher.

Other factors, such as sea ice, may also compromise the waste disposal packages. At the IARPC Workshop, presentations by Larry Phillips (U.S. Geological Survey) and Willie Weeks (University of Alaska) showed that on an annual to decadal scale, sea ice reworks much of the seafloor to depths greater than 50 m. As most of the disposal areas in the Kara Sea are in depths significantly more shallow than 50 m, many of the disposal areas (and by inference, the waste containers, some as much as 30 years old) have probably been impacted by the base of the sea ice (the ice keel). The Yablokov Report describes one instance where a radioactive piece of metal was recovered from a Nova Zemlya beach. It is highly likely that this piece of metal was picked-up or even possibly broken off of its seafloor source and then transported to the beach by being frozen in floating ice or ice push processes.

Question 4: What is the likelihood of barrels and other wastes being transported by currents and ice motions?

Response: It is our opinion that it is very unlikely that currents will be able to transport containers of waste from any of the dump sites. However, these currents could transport uncontained wastes significant distances. By uncontained wastes, we are referring to liquid waste, waste in solution, and waste bound in fine grained sediment. It is important to note that during transport, waste may be significantly diluted, with the quantity of dilution being directly related to the distance of the transport.

Sea ice is capable of entraining containerized waste and transporting it substantial distances. However, it is unlikely that liquid waste disposed in open water could find its way into forming sea ice. During spring flooding, Arctic rivers may carry wastes of various kinds into the Arctic Ocean marginal seas. If the sea surface is frozen, as is generally the case during spring river flooding, then suspended or dissolved fluvially transported wastes may be deposited on the surface of sea ice and incorporated into the ice section. Arctic sea ice can be transported for thousands of kilometers.

As was previously stated (response to Question 3), sea ice gouges much of the seafloor to water depths greater than 50 m. As most of the disposal areas in the Kara Sea are in depths significantly more shallow than 50 m, many of the disposal areas (and by inference, the waste containers, some as much as 30 years old) have probably been impacted by the base of the sea ice (the ice keel). Material sitting on the seafloor can be entrained into ice keels during the impact and gouging process. The case of the recovery of a radioactive piece of metal from a Nova Zemlya beach, presented in the Yablokov Report, is a likely example of sea ice transport and ice push processes.

To date, U.S. investigators have collected or have received from Russian counterparts little or, in most cases, no information about the leakage or transport of contaminants from individual dump sites located inthe Arctic's marginal seas. Even less in known about the presence or transport of contaminants uder the ice covered Arctic Ocean. Due to an absence of surface vessels or submersibles to systematically study the ice covered Arctic Ocean and the Arctic marginal seas, we also lack systematic regional information on water-column and ice processes that may distribute contaminants.

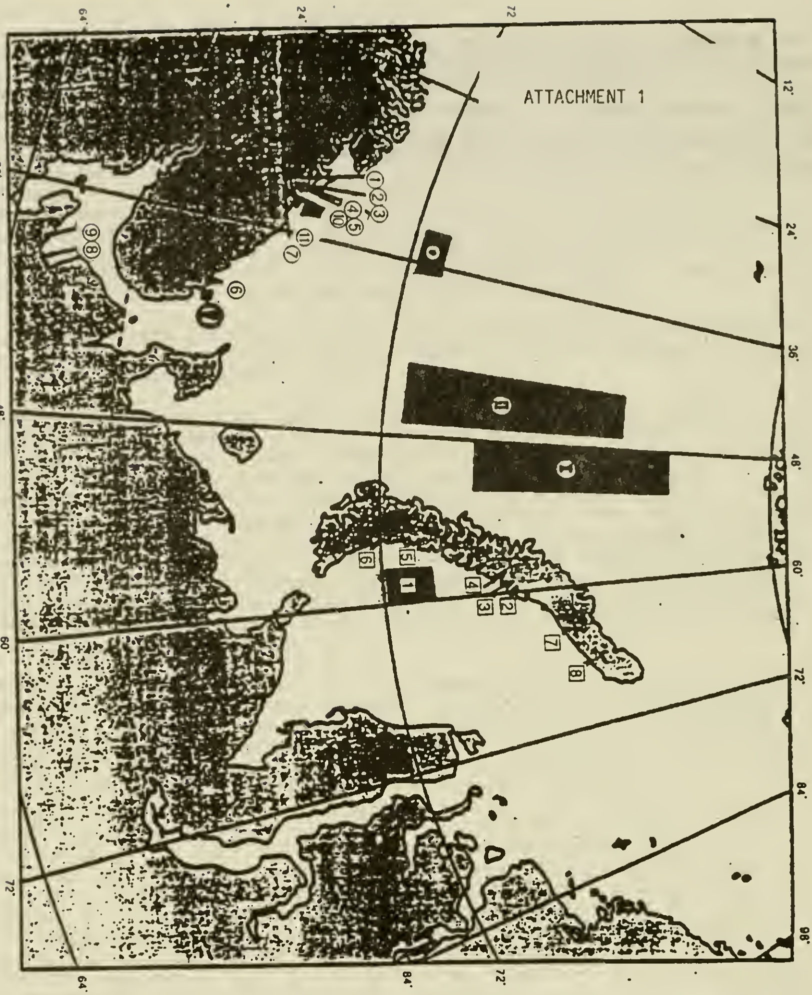
Question 5: Could you please catalogue, from the information which has been provided to this point, the wastes which have been dumped (including amounts, locations, isotopes, and half lives)?

Response: One of the most significant findings resulting from the IARPC Workshop was that there is a general absence of credible scientific information upon which to base a comprehensive risk analysis. Specifically missing is information about the amounts, isotopes, and half lives of materials dumped by the former Soviet Union. Virtually none of this information has been released by the Russian Federation. The little that we do know about locations and amounts comes from the Yablokov Commission Report and from a systematic analysis, based on the Report and educated assumptions, performed by Mark Mount, Michael Shaeffer, and David Abbott, all working at LLNL. Mount presented the results of this analysis at the IARPC Workshop. The information presented in Yablokov Report tables is reproduced at the end of these questions (Attachment 1).

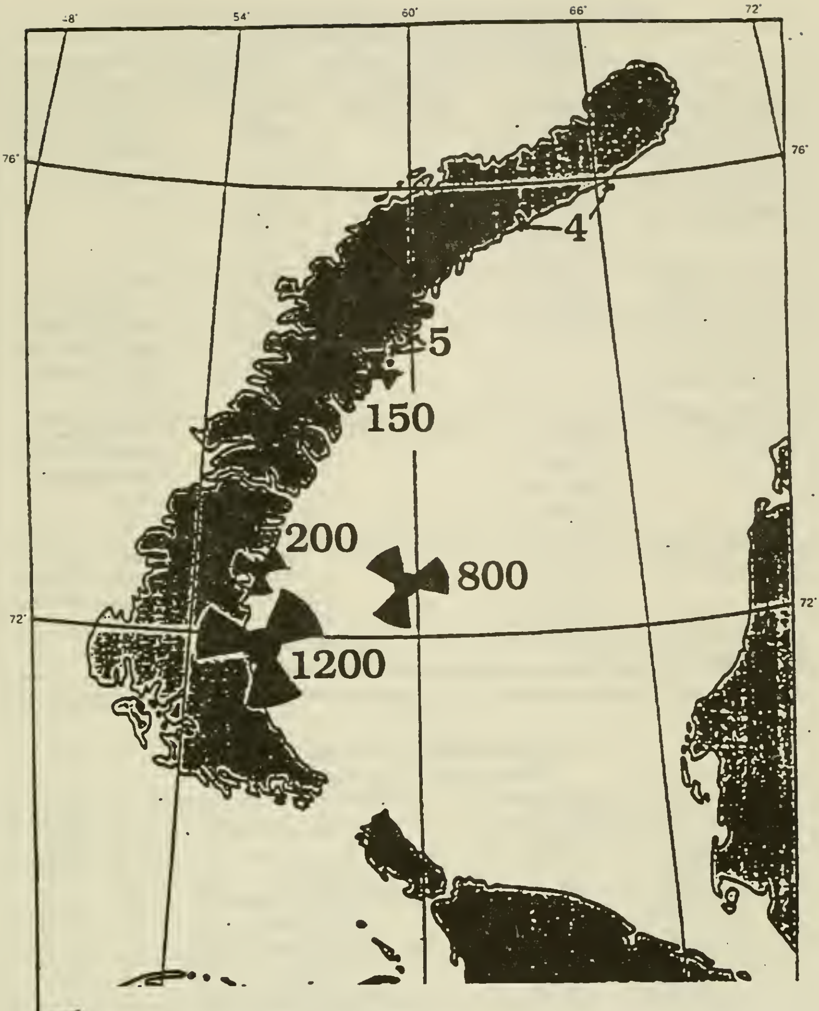
Mount's IARPC presentation was titled "Estimated Inventory of Radionuclides in Former Soviet Union Naval Reactors Dumped in the Kara Sea." A copy of this report is appended to these questions and answers (Attachment 2). Mount's presentation summarized materials dumped in the Abrosimov Inlet, the Tsivolka Inlet, the Stepovoy Inlet, the Techeniye Inlet, and the Nova Zemlya Depression between 1965 and 1988. Mount's summary describes an inventory of radionuclides at the time of dumping that included: reactor cores containing 17-66 thousand Curies (kCi) of actinides plus daughter decay products and 1,695-4,782 kCi of fission products; reactor components containing 917-1,127 kCi of activation products; and primary system corrosion products consisting of 1.4-1.6 kCi of activation products. Mount's calculations suggest that today, the disposed reactor cores contain 6-26 kCi of actinides plus daughter decay products and 492-540 kCi of fission products; reactor components containing 124-126 kCi of activation products; and primary system corrosion products consisting of 0.16-0.17 kCi of activation products. Twenty years from now, the remaining radionuclide component will consist of disposed reactor cores containing 3-12 kCi of actinides plus daughter decay products and 303-333 kCi of fission products; reactor components containing 63.5-64 kCi of activation products; and primary system corrosion products consisting of

0.014-0.015 kCi of activation products. A Curie is a measure of radioactivity equal to the disintegration of 3.7×10^{10} atoms per second.

Efforts are being made by U.S. scientists and their Russian colleagues to improve upon these numbers. However, the Mount summary is still the best indication of the quantity and type of radionuclides disposed in the Arctic marginal seas.



Location of Major Radioactive Waste Sources and Disposal Areas in Northern Seas [14].
Northern Fleet Bases: *1*—Nerpichya Bay; *2*—Andreyev, Bolshaya Lopatka and Malaya Lopatka Bays; *3*—Olenya and Sayda Bays; *4*—Ara Bay; *5*—Pala Bay; *6*—Yokanga. Holding and Recycling Sites for Decommissioned Nuclear-Powered Naval Vessels and Ships: *4*—Polyarny; *6*—Yokanga; *7*—Murmansk (Nuclear Fleet Radio Regiment); *8*—Severodvinsk (water area of Zvëzdochka Shipyard, North Production Association). Temporary Storage Sites for Spent Nuclear Fuel: *1*—Andreyev Bay; *6*—Yokanga; *7*—Mother ships *Imandra, Lepse.* and *Lotta*; *2*—Navy tender for refueling reactors of NS's. Shipyards: *8*—Severodvinsk (Northern Machinery Enterprise Production Association, North Production Association); *4*—Polyarny (Naval shipyard); *4*—Vyuzhny (Nerpa Shipyard). Not shown on map: Saint Petersburg (Baltic Yard Production Association, Admiralty Production Association), Nizhniy Novgorod (Krasnoye Sormovo Production Association). *I, V*: LRW dumping sites. *I, VIII* (boxed): SRW disposal areas.



Expert Estimates of Maximum Possible Total Activity (at time of disposal) of All Forms of Solid Radioactive Waste in the Kara Sea.
Size of symbol is proportional to activity; figures are in kCi. Exact coordinates of areas are given in Tables A3 and A4.

Objects with Spent Nuclear Fuel Dumped in Northern Seas

Object	Coordinates. Year	Depth. meters	Total Activity (max.). kCi*	Radionuclide Content	Description of Protective Barriers
Compartment of NS No. 285 with two reactors. one containing SNF in place (see also Table 4)	71°56'2" N. 55°18'5" E. Abrosimov Inlet. 1965	20	800	Fission products	Stock reactor compartment and interior structures filled with furfurol mixture
Compartment with two reactors containing SNF from NS No. 901	71°56'2" N. 55°18'9" E. Abrosimov Inlet. 1965	20	400	Fission products	Same
Shielding assembly of reactor from OK-150 unit of nuclear icebreaker *Lenin* with residual SNF (60% of fuel complement based on UO_2)	74°22'1" N. 58°42'2" E. Tsivolka Inlet. 1967	49	100	^{137}Cs (~50 kCi). ^{90}Sr (~50 kCi). ^{238}Pu. ^{241}Am. ^{244}Cm (~2 kCi)	SNF residue bound by furfurol-based mixture. shielding placed in reinforced concrete container and metal shell
Reactor from NS No. 421 with SNF	72°40' N. 58°10' E. Novaya Zemlya Depression. 1972	300	800	Fission products	Metal container with lead shell dumped along with barge
NS No. 601 with two reactors containing SNF	72°31'15" N. 55°30'15" E. Stepovoy Inlet. 1981	50	200	Fission products	Stock reactor compartment and interior structures filled with furfurol mixture
Total: 5 objects with 7 reactors containing SNF	1965-1981		2300		

*—Expert estimates were made at the time of sinking, based on power generated by NS reactors (12.5 GW/day).

Characteristics of Solid Radioactive Waste Disposal Areas in the Kara Sea

Area	Coordinates		Geographic Location	Depth, meters
	N. Lat.	E. Long.		
1	72°5' 73°17'	57°30' 60°0'	Kara Sea, Novaya Zemlya Depression	380
2	74°40' 74°42'	59°53' 60°17'	Sedov Inlet, east coast of Novaya Zemlya	13-33
3	74°35'1" 74°7'	59°18' 59°12'	Oga Inlet, east coast of Novaya Zemlya	24
4	74°22'3" 74°22'0"	58°42'1" 58°41'0"	Tsivolka Inlet, east coast of Novaya Zemlya	56-135
5	72°33'4" 72°32'4"	55°34' 55°23'3"	Stepovoy Inlet, east coast of Novaya Zemlya	25-27
6	71°56'5" 71°56'0"	55°22'1" 55°19'11"	Abrosimov Inlet, east coast of Novaya Zemlya	12-20
7	75°40'9"	63°59'	Blagopoluchiye Inlet, east coast of Novaya Zemlya	13-16
8	75°58' 75°59'	66°20' 66°18'	Techeniye Inlet, east coast of Novaya Zemlya	up to 50

Characteristics of Liquid Radioactive Waste Discharge Areas in Northern Seas

Area	Coordinates		Geographic Name	Depth, meters	Remarks
	N. Lat.	E. Long.			
1	78°0' 78°0' 74°0' 74°0'	48°0' 52°0' 48°0' 52°0'	Barents Sea	180-300	Open sea
2	77°0' 77°0' 72°30' 72°30'	43°0' 47°0' 43°0' 47°0'	Barents Sea	200-300	Open sea
3.	72°45' 72°45' 72°15' 72°15'	33°30' 36°30' 33°30' 36°30'	Barents Sea	200-300	Open sea
4	69°51' 69°51' 69°34' 69°34'	34°15' 34°51' 34°15' 34°51'	Barents Sea	100-200	Coastal
5	68°18' 68°18' 68°10' 68°10'	40°13' 40°36' 40°13' 40°36'	Barents Sea	50-100	Coastal

Summary Data on Low- and Intermediate-Level Solid Radioactive Waste Dumped in the Kara and Barents Seas

Area	Activity		Number of Dumpings	Years	Remarks
	Ci	TBq			
1	3320	123	22	1967-1991	3174+? C, 9 LO, 8 V
2	3410	126	8	1982-1984	1108 C, 104 LO
3	2027	75	8	1968-1983	472+? C, 4 LO, 1 V
4	2684	99	8	1964-1978	1600+? C, 6 LO, 1 V
5	1280	47	5	1968-1975	5 LO
6	661	25	7	1966-1981	8+? C, 7 LO, 4 V
7	235	8	1	1972	1 LO
8	1845	68	3	1982-1988	146+? C, 18 LO, 1 V
Off Kolguyev Island	40	1.5	1	1978	1 V
Chernaya Bay (Novaya Zemlya)	300	11	1	1991	1 LO
Barents Sea	>100	>4	1	?	Barge with solid RW in welded hold
Total	~6000	~590	65		6508+? C, 155 LO, 17 V

Key to Remarks: *C*—containers; *LO*—large objects; *V*—vessels.

Objects without Spent Nuclear Fuel Dumped in Northern Seas, 1965-1968

Object	Coordinates, Year	Depth, meters	Total Activity	Radionuclide Content	Description of Protective Barriers
Reactor of NS No. 285 (see Table 3)	71°56'2" N. 55°18'5" E. Abrosimov Inlet, 1965	20	Requires special analysis	Unclear	Stock reactor compartment structures
Reactor compartment (two reactors) from NS No. 254	71°55'13" N. 55°32'32" E. Abrosimov Inlet, 1965	20	Requires special analysis	Unclear	Stock reactor compartment structures
Reactor compartment (two reactors) from NS No. 260	71°56'2" N. 55°18'5" E. Abrosimov Inlet, 1966	20	Requires special analysis	Unclear	Stock reactor compartment structures
OK-150 nuclear power plant from icebreaker *Lenin*, comprising three reactors with primary loop pipelines and watertight stock equipment	74°26'4" N. 58°37'3" E. Tsivolka Inlet, 1967	50	~50 kCi	Mainly ^{60}Co	Biological shielding unit (B-300 steel, concrete)
Two reactors from NS No. 538	73°59' N. 66°18' E. Techeniye Inlet, 1988	35-40	Requires special analysis	Unclear	Metal container with lead shell
Total: 5 objects with 10 reactors without SNF	1965-1988	20-40	Requires special analysis (possibly up to 100 kCi at time of dumping)		

Anthropogenic Radionuclide Budget of the Barents and Kara Seas Ecosystem, 1961-1990

Source of Long-Lived Radionuclides	Barents Sea		Kara Sea		Ecosystem as a Whole		
	Activity		Activity		Activity		Contribution
	kCi	TBq	kCi	TBq	kCi	TBq	%
1. Atmospheric fallout	100	3700	70	2600	170	6300	6.2
2. River runoff	6.0	200	33.0	1200	39	1400	1.4
3. Contributions from Gulf Stream system	200	7400	—	—	200	7400	7.3
4. Dumping of solid and liquid RW	13	480	16	600	30	1100	0.7
5. Sinking of SRW with SNF	—	—	2300*	85300*	2300*	85100	84.4
6. Underwater and surface nuclear explosions	...(No data)...						
Total (upper limit)	319	11780	2419	89700	2739	101300	100

*—Expert estimate of the upper limit of activity at the time of disposal.

Information on Radioactive Objects that Have Fallen into the World's Oceans Through Accidents with Soviet Submarines

Object	Location, Date	Depth, meters	Maximum Reactor Activity, kCi	NWH Activity at Time of Accident, Ci	Remarks**
Diesel submarine	Pacific Ocean, Hawaiian Islands, April 1968	6,000	None	1.0	Bow section with NWH's raised in August 1974 by *Glomar Explorer* (activity 0.4 kCi)
Nuclear submarine	Bay of Biscay, 4/8/1970	4,000	250*	0.8	2 nuclear power plants
Nuclear submarine	Bermuda Islands, 10/6/1986	5,500	250*	3.8	2 nuclear power plants
NS *Komsomolets*	Norwegian Sea, 4/7/1989	1,685	150*	0.43	1 nuclear power plant
Total			650	6.03	

*—Expert estimate (at time of sinking)

**—The world's oceans contain a total of 50 NWH's from various countries [22].

Summary Data on the Scale of Contamination of the World's Oceans by Radioactive Wastes from USSR Territory, 1961-1990

Source of Contamination	Location and Date	Suspected Total Activity, kCi*
LRW from Navy and Murmansk Maritime Shipping Line	North Atlantic Ocean. Northwest Pacific Ocean. 1959-1991	About 25 Over 12
SRW from Navy and Murmansk Maritime Shipping Line, including sunken reactors	Same	About 300 (experts estimate not over 2,500)
Sunken NS's	Atlantic and Pacific Oceans	Under 650
Lost NWH's, RTG's, satellites, etc.	Atlantic, Indian and Pacific Oceans	Several thousand
Discharge of RW from Yenisey and Ob Rivers	Arctic Seas	Several thousand
Total	All the world's oceans	Not over 10,000

*—At time of disposal.

Characteristics of Liquid Radioactive Waste Discharge in Northern Seas

Year	Area 1		Area 2		Area 3		Area 4		Area 5		Total, Areas 1-5	
	Volume, m^3	Activity, Ci (TBq)	Volume, m^3	Activity, Ci (TBq)	Volume, m^3	Activity, Ci (TBq)	Volume, m^3	Activity, Ci (TBq)	Volume, m^3	Activity, Ci (TBq)	Volume, m^3	Activity, Ci (TBq)
1960			760	0.21								
1961			930	16.5								
1962			850	4.61								
1963			1054	358.15								
1964			910	153.11								
1965			6520	963.62								
1966			3540	366.84	1220	5.97			449	1.01		
1967			144	30.17	530	2.2			2000	2.69		
1968	353	2.81			1357	0.50			1400	1.52		
1969	316	109.51	3416	51.87	1290	0.29			750	0.41		
1970	2703	65.42			4370	96.13			2257	0.56		
1971			2371	20.65	1096	3.62			1549	1.41		
1972	850	5.9	930	19.5	4101	101.33			2560	8.40		
1973	882	22.0	4057	76.6	3872	129.36			885	4.00		
1974			8645	265.7	3155	321.3			838	0.80		
1975	1947	430.0	4720	55.27	851	15.3	835	6.35	1610	8.16		
1976	1800	63.0	6229	75.9	2788	811.9			830	11.20		
1977	1500	68.32	4150	47.35	860	1.5			870	8.70		
1978	340	30.19			5170	90.25						
1979	604	12.01			7286	78.42						
1980	650	27.06	3405	22.32	3957	37.67			800	8.00		
1981			2146	268.27	2130	201.06	906	3.99	2755	21.13		
1982	1250	169.0	1745.4	11.07	1476.6	18.52			1855	9.70		
1983	685	72.41	1772.1	265.34	472	11.06			3247	22.34		
1984			5125.4	222.13	820	5.99	740	2.78	1614.8	51.38		
1985					2376.6	65.85			3980.5	21.9		
1986			900	10.59	870	29.49	1410	5.74	3410	23.73		
1987			1740	34.8	780	14.7	2211	22.38	2063	20.61		
1988	364.5	5278.51										
1989					2472	39.76	875	1.41	2752	11.10		
1990			751	0.84			1267	7.12	5913.6	59.03		
1991							263.2	3.99	2382.8	19.61		
Total	14244	6356 (235)	66811	3341 (123)	53300	2082 (77)	8507	54 (2)	46772	317 (12)	189634	12153 (450)

Year	Discharge Outside Areas 1-5		
	Volume, m^3	Activity, Ci (TBq)	Remarks
1959	600	0.00	65°44' N, 35°54' E, White Sea
1960	100	0.2	Near Gogland Island, Baltic Sea
1965	100	100	Severodvinsk, explosion at plant
1976	?	8500	Kara Sea, LRW from nuclear icebreaker *Lenin*
1982	?	1000	Andreyev Bay, reservoir leak
1989	?	2000	Ara Bay, accident aboard an NS
Total	800 +?	11600 (429)	
Areas 1-5	189634	12153 (450)	
Grand Total	190434 +?	23753 (879)	

Table A Characteristics of Solid Radioactive Waste Dumping in Northern Seas

Year	Coordinates		Volume, m^3	Activity (^{90}Sr equivalent, Ci)	Form of Disposal		
	N. Lat.	E. Long.			Containers	Ships	Unenclosed
Area 1. Kara Sea							
1967	73°17'3	59°54'	212	35.3			Main circulating pump from nuclear icebreaker *Lenin* (3 pcs.)
1967	72°21'	57°50'18"	910	359		Steamer *José Diaz*	
1968	73°06'	59°10'	150	5.6		Barge No. 3	
1969	Area 1		144.8	159.2	?	?	?
1970	73°11'	59°54'	144	5.6	?	?	?
1972	72°24'	57°55'	?	160		Lighter *Savany*	
1973	72°23'	58°0'	?	?		Tanker *TNT15*	
1974	72°11'	57°40'	?	?		Lighter *Oma*	
1975	72°38'	58°20'	5000	30		Lighter *L-3*	
1977	72°19'22"	57°46'	600	0.6		*MBSN-801250*	
1980	72°18'1"	57°36'4"	243	118.4			
1980	72°15'	57°35'	?	?			
1984	72°15'	57°30'	295.1	248.6	Containers (V+)		
1984			4.0	5.8			Class III furfurol-acetone resin (V+)
1984			3.0	14.8			Primary loop circulating pump
1985	72°21'	57°50'18"	5182.1	738.24	1027		SRW
1985	73°06'	59°10'	693.26	506.99	535		
1986	72°21'	57°50'18"	419.4	156.83	321		
1987	73°06'	59°10'	1302.3	628.14	847		Steam generator, primary loop circulating pump
1989	73°06'	59°10'	370.26	87.095	256		
1989	72°21'	57°50'18"	142	24.18	57		
1991	73°17'3"	59°54'	264.4 54.5	20.66 14.92	131		SRW
Total			16134	3320 (123)	3174	8	9

Table A (continued)

Year	Coordinates		Volume, m^3	Activity (^{90}Sr equivalent, Ci)	Form of Disposal		
	N. Lat.	E. Long.			Containers	Ships	Unenclosed
Area 2. Sedov Inlet							
1982	74°40'	59°55'	?	100			
1982	74°40'	59°55'	2357.6	1718.2	298		91 4k-650B bundles
1982	74°42'	69°56'	218.4	63.56	182		
1982	74°41'	59°53'	276	118.32	230		
1983	74°40'	59°56'	280.5	1121.44	231		
1984	74°41'	60°17'	136.5	172.8	108		
1984	74°41'	60°17'	3.0	6.0			Furfurol-acetone resin (6 pcs.)
1984	74°41'	60°17'	10.5	52.5			Primary loop circulating pump
1984	74°41'	60°17'	150.9	57.21	59		Steam generator
Total			3433	3140 (126)	1108		104
Area 3. Oga Inlet							
1968	74°07'	53°12'	400	4		Barge *SB-5*	SRW
1976	74°35'1"	59°15'4"	560	929			
1978	74°17'	58°18'	170	15.5			SRW
1980	74°35'	59°14'	278	274.35			SRW
1980	74°35'	59°14'	500	59.21			
1981	?	?	?	349.06	containers, ?		SRW
1983	74°35'	59°13'5	540	205.32	212		
1983	74°35'1"	59°13'1"	580	190.6	260		
Total			3028	2027 (75)	472+?	1	4
Area 4. Tsivolka Inlet							
1964	74°22'3"	58°41'	640	977.37	1600	Special lighter *N. Bauman*	SRW
1965	74°22'3"	58°41'	266	448.96			SRW
1966	74°22'3"	58°41'	446	534.17			SRW
1967	74°22'3"	58°42'	240	374.97			SRW
1967	74°22'2"	58°41'5"	25.2	28.64			SRW
1967	74°22'3"	58°42'1"	72.2	77.2			SRW
1976	74°22'	58°42'	1233	12		Special lighter *Kolezhma*	
1978	74°22'	58°41'	438	230.5	?		
Total			3360	2684 (99)	1600+?	2	6

Table A (continued)

Year	Coordinates		Volume. m^3	Activity (^{90}Sr equivalent. Ci)	Form of Disposal		
	N. Lat.	E. Long.			Containers	Ships	Unenclosed
Area 5. Stepovoy Inlet							
1968	72°32'4"	55°33'9"	185.2	184.78			SRW from nuclear ice-breaker *Lenin*
1970	72°33'	55°29'2"	243	371.12			SRW
1972	72°33'2"	55°26'2"	242	212			SRW
1973	72°33'2"	55°23'3"	532	325.24			SRW
1975	72°33'4"	55°24'	445	187			SRW
Total			1647	1280 (47)			5
Area 6. Abrosimov inlet							
1966	71°56'1"	55°19'5"	?	?		Barge	
1967	71°56'5"	55°21'5"	?	0.28		Barge *MNN-231500*	
1967	71°56'	55°21'	?	30		Barge *MBSN-378250*	SRW
1974	71°56'0"	55°21'0"	520	229			
1977	71°55'3"	55°22'1"	254.8	387	8		
1980	71°56'	55°21'	750	10		Lighter *L-8711*	Steam generators (5 pcs.). SRW
1981	71°56'	55°21'2"	392	5	?		
Total			1917	661 (24.5)	8+?	4	7
Area 7. Blagopoluchiye Inlet							
1972	75°40'9"	63°39'	331	234.84			SRW from *Lenin*
Total			331	235 (8)			1
Area 8. Techeniye Inlet							
1982	76°58' "	66°20' "	91.2 84.0	29.34 4.0	76 70		
1988	73°59'	66°18'	229	1811.21		Lighter No. 4	.
Total			404	1845 (68)	146	1	

Table A (continued)

Year	Coordinates		Volume, m^3	Activity (^{90}Sr equivalent, Ci)	Form of Disposal		
	N Lat.	E. Long.			Containers	Ships	Unenclosed
Outside Areas 1-8							
1978	69°34'1"	47°56'3"*	1100	40		Lighter *Nikel*	Cruise missiles (7 pcs.), steam generators (5 pcs.), PR-50's (2 pcs.), warheads (4 pcs.)
Total			1100	40 (1.5)		1	18
Grand Total			31534	15502 (574)	6508	17	154

*—20 miles northwest of Kolguyev Island, possible coordinates 69°34'0" N, 47°56'2" E.

ATTACHMENT 2

ESTIMATED INVENTORY OF RADIONUCLIDES IN FORMER SOVIET UNION NAVAL REACTORS DUMPED IN THE KARA SEA

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Abstract

Radionuclide inventories have been estimated for the reactor cores, reactor components, and primary system corrosion products in the former Soviet Union naval reactors dumped at the Abrosimov Inlet, Tsivolka Inlet, Stepovoy Inlet, Techeniye Inlet, and Novaya Zemlya Depression sites in the Kara Sea between 1965 and 1988. For the time of disposal, the inventories are estimated at 17 to 66 kCi of actinides plus daughters and 1,695 to 4,782 kCi of fission products in the reactor cores, 917 to 1,127 kCi of activation products in the reactor components, and 1.4 to 1.6 kCi of activation products in the primary system corrosion products. At the present time, the inventories are estimated to have decreased to 6 to 24 kCi of actinides plus daughters and 492 to 540 kCi of fission products in the reactor cores, 124 to 126 kCi of activation products in the reactor components, and 0.16 to 0.17 kCi of activation products in the primary system corrosion products. Twenty years from now, the inventories are projected to be 3 to 12 kCi of actinides plus daughters and 303 to 333 kCi of fission products in the reactor cores, 63.5 to 64 kCi of activation products in the reactor components, and 0.014 to 0.015 kCi of activation products in the primary system corrosion products. All actinide activities are estimated to be within a factor of two.

Introduction

In the Spring of 1993, a Russian report, "Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territory of the Russian Federation,"[1] was released. The findings presented in this Russian report were the result of a scientific study commissioned by the Office of the President of the Russian Federation and headed by Dr. Alexi V. Yablokov. The Yablokov Commission, as they were later called, reported that 16 naval reactors from seven former Soviet Union submarines and the icebreaker *Lenin*, each of which suffered some form of reactor accident, were dumped at five sites in the Kara Sea.

Six of these 16 naval reactors contained their spent nuclear fuel (SNF). In addition, approximately 60% of the SNF from one of the three *Lenin* naval reactors was disposed of in a reinforced concrete container and metal shell. The Yablokov Commission estimates of radioactivity were limited to the fission products in the SNF and the ^{60}Co in the reactor components, both at the time of disposal. With rare exception, specific radionuclides were not identified and there was no estimate provided for the current levels of radioactivity.

Without a knowledge of the specific radionuclides and their current levels of radioactivity, the health risks to man from these 16 former Soviet Union naval reactors and their SNF are difficult to predict. This report presents the results of an independent effort to provide the necessary time-dependent inventory of the radionuclides.

Background Information

The information presented herein highlights the conclusions of the Yablokov Commission and what we know or have assumed about the history of each submarine. Table 1 presents the Yablokov Commission findings for the five Kara Sea disposal sites.[1] Summarized for each disposal site is the disposal date, the number of discarded naval reactors and their associated ship identification number, the number of discarded naval reactors containing SNF, and the estimated fission product radioactivity in the SNF at the time of disposal. The Tsivolka Inlet entries are for the icebreaker *Lenin* and the reinforced concrete container and metal shell containing approximately 60% of the SNF from one of the three OK-150 power plant naval reactors that were discarded in 1967. The 100 kCi reported for the *Lenin* disposal result primarily from the fission products ^{90}Sr and ^{137}Cs. The two naval reactors containing SNF that were discarded in the Stepovoy inlet in 1981 are identified as being of a liquid metal cooled type. The Yablokov Commission estimates of total radioactivity are 2,300 kCi of fission products in the SNF and 100 kCi of ^{60}Co in the reactor components. No information was provided which would allow association of a given ship identification number with a specific submarine class or accident date.

To estimate the time-dependent inventory of radionuclides in the discarded naval reactors, reactor core operating histories and the accident date associated with each discarded naval reactor are required. Unfortunately, reactor core histories for the seven former Soviet Union submarines were not available. Therefore, an analytical model was developed to estimate the minimum reactor fuel load for each submarine whose discarded naval reactors contained SNF. As will be discussed later, the model uses as its basis Western estimates of the shaft horsepower of each submarine involved. Selection of an appropriate shaft horsepower requires a knowledge of each submarine's NATO classification.

Table 2 presents a summary of the Western estimates of the identities of the submarines whose naval reactors were dumped in the Kara Sea.[2,3] Summarized for each submarine is the K identification number, NATO classification, and associated reactor accident date. The two naval reactors in the K-27 are reported to have been of a liquid metal type.[3] All other discarded naval reactors are believed to have been of the pressurized water reactor (PWR) type.[4] Three of these submarines, K-3, K-11, and K-19, were observed in active service some years after suffering their reactor accidents. While each of the seven identified submarines was reported to have suffered some form of reactor accident, none was reported to have sunk.

With the information of Table 2 as a basis, a NATO classification was assigned to the ship identification of each submarine whose discarded naval reactors contained SNF. Table 3 presents a summary of our deductions. Summarized for each disposal date is the number of discarded naval reactors containing SNF and associated ship identification number, the K identification number, and the NATO classification. The rationale for our selections was as follows. A recent International Atomic Energy Agency publication[3] identifies three of the four submarines whose naval reactors were discarded in 1965 and 1966 as the K-3, K-11, and K-19. In addition, the submarine whose two naval reactors were discarded in 1981 is identified as the K-27. Since the Yablokov Commission report specified that the minimum time period between reactor shutdown and disposal was one year, we believe that the two submarines associated with the three naval reactors containing SNF that were discarded in 1965 are the K-3 and K-19. Since the first K-3 submarine reactor accident involved no fatalities and she was observed in active service some years later,[2] one may infer that while both naval reactors were undoubtedly replaced, only one of the two discarded naval reactors contained SNF. Furthermore, since the K-19 submarine reactor accident involved fatalities, the accident was of such severity that she was nicknamed "Hiroshima," and she was observed in active service some years later,[2] one may infer that both naval reactors were removed and that each contained SNF. Thus, the K-3 was assigned to the ship identified as No. 285, and the K-19 was assigned to the ship identified as No. 901. Through a similar process of elimination, the submarine associated with the one naval reactor containing SNF that was discarded in 1972 was assigned to the K-140. The three remaining submarines, K-5, K-11, and K-22, are assumed to be associated with discarded naval reactors without SNF.

Analytical Model

The information presented herein describes (1) the analytical model used to estimate the minimum reactor fuel load for each submarine whose discarded naval reactors contained SNF, (2) the information that we know or have assumed about the operating characteristics of the icebreaker *Lenin* and each submarine whose discarded naval reactors contained SNF, and (3) the method used to predict the activation product inventories in the reactor components and primary system corrosion products of all discarded naval reactors.

With an estimate of the reactor fuel load, the reactor power, and the reactor operating history, one can proceed to calculate the radionuclide inventory associated with the SNF. Before describing the computer code that was used to estimate the inventory, the information that is required as input must be addressed. In the case of the icebreaker *Lenin*, core history information necessary to the inventory calculations was directly available from Russian sources.[5,6] Table 4 presents a summary of the naval reactor core information for the icebreaker *Lenin*. Summarized for each of the three *Lenin* reactors is the ^{235}U loading, the operating period, and the number of effective full power hours. From the information contained in Table 4, the average full power of each reactor is calculated to be 65 megawatts thermal (MW). Each of the three *Lenin* reactors were reported to contain 219 fuel assemblies with a ^{235}U enrichment in the range of 4.6 to 6.4%. The reactor accident that precipitated the need for disposal of the three naval reactors and a portion of one's SNF occurred either early or late in the year of 1966, some three years after the reactors were refueled. The Yablokov Commission report states that SNF from 125 fuel assemblies, or approximately 60% of the fuel complement from one OK-150 reactor, was discarded. The number of fuel assemblies that this 60% finding implies is on the order of 208, which is in excellent agreement with the 219 fuel assemblies previously reported for each *Lenin* reactor. As such, added credence is given to the *Lenin* core history information.

For national security assets such as nuclear powered submarines, core history information like that published on the *Lenin* is virtually impossible to obtain. As such, a method for estimating the necessary reactor fuel load had to be developed. Assuming one knows the operating characteristics of the submarine, estimates of the reactor fuel load can be made from the power requirements of the submarine. For a submarine to operate at a given speed, S_i, the power requirement, P_i, in MW, is given by:

$$P_i = (SHP)\,(CF_1)\,(S_i\,/S_{max})^3$$

where

SHP = shaft horsepower, hp, and

CF_1 = 0.7457×10^{-3} MW/hp.

The overall power requirement of the reactor, P_R, in MW, is given by:

$$P_R = [(P_i / PE) + HL]/N_R$$

where

PE = propulsion efficiency,
HL = "hotel" load requirements, MW, and
N_R = numbers of reactors.

The propulsion efficiency is that of the plant, and includes both thermal and mechanical conversion. The "hotel" load represents the total thermal power requirements of the submarine for all electric power and steam loads.

The minimum quantity of ^{235}U required to power the submarine for a specific duration, $^{235}UL_{min}$, in grams, is given by:

$$^{235}UL_{min} = (CF_2)\,(P_R)\,(AST)\,(CL)$$

where

CF_2 = 1.24 grams ^{235}U/MWd,

AST = at-sea time, d/y, and

CL = core life, y.

The minimum quantity of U in the submarine reactor fuel load, UL_{min}, in grams, is given by:

$$UL_{min} = {}^{235}UL_{min}/E_U$$

where

E_U = enrichment of ^{235}U.

Note that the minimum quantity of U in the reactor fuel load, UL_{min}, is not the amount that is actually predicted to be loaded in the submarine, but rather the minimum quantity of U required for the submarine to operate at speed S_t for a time period equal to the product of the at-sea time and core life. A substantially greater amount of U would be required for a full reactor load.

Table 5 presents a summary of the basic data used to estimate the minimum quantity of U in the reactor fuel load for each submarine whose discarded naval reactors contained SNF. Summarized for each of the various parameters is the range of values and the value assumed. The average speed at which each submarine was assumed to operate was arbitrarily set at 11 knots. For the shaft horsepower and maximum speed of the submarines, the average of the range of values was assumed. In the case of the propulsion efficiency, hotel load, at-sea time, and core life, the value assumed was the range limit or value that would maximize the minimum quantity of U in the reactor fuel load. The value limits on enrichment are a best estimate from the available data. While the lower range limit is considered nominal for first-generation submarines of the November and Hotel class, the inclusion of a Yankee II class submarine requires the assumption of a range in enrichment.

The radionuclide inventory in the SNF of the discarded naval reactors was calculated with ORIGEN2,[13] a point (no spatial dependence) depletion personal computer code that has been used extensively to characterize spent nuclear fuel and high level waste. The ORIGEN2 fixed data library used in these estimates is that for a generic PWR fueled with UO_2 enriched to 4.2% in ^{235}U at a burnup of 50,000 MW days per metric tonne of U. A number of factors were considered in the selection of this particular library. First, 14 of the 16 discarded naval reactors are believed to be of the PWR type. Second, since the *Lenin* fuel matrix was described in the Yablokov Commission report as UO_2, it follows that the fuel matrix in first-generation submarine naval reactors built during the same period of time was also very likely UO_2. Third, the lowest ^{235}U enrichment in the *Lenin* reactors was quite close to 4.2%.

The highest ^{235}U enrichment considered for the former Soviet Union submarines is substantially greater than 4.2%. One might expect that as the ^{235}U enrichment is increased, there will be a proportional decrease in the production of actinides. This is not the case; as the ^{235}U enrichment is increased, the neutron energy spectrum can be expected to harden or shift toward higher energies. With this shift in neutron spectrum, more resonance absorptions are expected to occur, which, in turn, will lead to a relative increase in the production of actinides. For a ^{235}U enrichment of 36%, the use of ORIGEN2 may result in an underestimate of the actinides by as much as a factor of two. The effect of a ^{235}U

enrichment of 36% on the ORIGEN2 fission product estimate is believed to be significantly less. A more accurate estimate of the actinides in the higher enrichment fuels may be calculated with the computer code ORIGEN-S.[14] However, to perform this calculation, one must know either the relative shape and magnitude of the neutron energy spectrum or the composition and dimensions of a reactor fuel assembly or unit cell. Since information such as this was not readily available, the limitation in the prediction of the actinide inventory associated with the use of ORIGEN2 was considered acceptable.

To predict the activation product inventories in the reactor components and primary system corrosion products of the discarded naval reactors, the results of a British calculation for a generic nuclear powered submarine one year after shutdown were used.[15,16] Table 6 presents a summary of the British results. Summarized for each of the selected activation products are the radionuclide half-life, reactor component radioactivity, and primary system corrosion product radioactivity. Since the reactor power level of a typical first-generation British submarine is similar to Western estimates of the reactor power levels of the discarded naval reactors, it follows that the data of Table 6 may be used without exception. For the reactor components the estimated total radioactivity is 79,100 Ci, with ^{55}Fe, ^{60}Co, and ^{63}Ni as the most dominant radionuclides, respectively. For the primary system corrosion products, the estimated total radioactivity is reduced to 111 Ci, with ^{60}Co as the most dominant.

Characteristics of Selected Radionuclides

The inventory of radionuclides in this estimate is limited in scope. For the most part, the inventory consists of radionuclides with long half-lives or which are of concern as ingestion products, the most likely pathway of dose to man. Table 7 presents a summary of the characteristics of the selected actinide, fission product, and activation product radionuclides in the inventory. Summarized for each selected radionuclide is the radionuclide half-life, type of radiation emitted, average energy associated with each radiation type, and the annual limit on intake for ingestion. The annual limit of intake for ingestion represents the quantity of a given radionuclide that, when ingested over a period of one year, will result in a dose of 5 rem. For simplicity, the radionuclides of a given type - actinide, fission product, or activation product - have been arranged in order of decreasing toxicity. With the exception of ^{241}Pu, the actinides are the most toxic of the selected radionuclides in the inventory. The toxicity of ^{241}Pu is greater than that of ^{134}Cs and less than that of ^{90}Sr. With the exceptions of ^{60}Co and ^{14}C, the activation products are the least toxic of the selected radionuclides in the inventory. The toxicity of ^{60}Co is greater than that of ^{154}Eu and less than that of ^{137}Cs. The toxicity of ^{14}C is equivalent to that of ^{125}Sb.

Results

The maxima and minima in the estimated inventory of radionuclides presented herein were developed through an assessment of the variability of two key parameters: ^{235}U enrichment and time between reactor shutdown and disposal of the SNF. The effect of ^{235}U enrichment on the estimated inventory of radionuclides was evaluated for the *Lenin* and submarine naval reactors in the following way. In the case of the SNF from one of the three *Lenin* naval reactors, the reported range in ^{235}U enrichment was assumed to be associated with a single three-reactor core load. Under a further assumption that the three *Lenin* reactors were loaded with approximately equal quantities of U, the ^{235}U enrichments of 4.6% and 6.4% were associated with the two reactors loaded with 76 and 80 kg of ^{235}U and the one reactor loaded with 129 kg of ^{235}U, respectively. In the case of the six submarine naval reactors containing SNF, the assumed minimum and maximum in ^{235}U enrichment were associated with separate reactor core loads.

The effect of time between reactor shutdown and disposal, or decay time, on the estimated inventory of radionuclides was evaluated by assuming a minimum decay time and a best estimate decay time for each naval reactor and disposal site. By definition, the minimum decay time for each naval reactor was chosen such that the estimate of the inventory of radionuclides at the time of disposal would be a maximum, and the best estimate decay time for each naval reactor was chosen such that a more realistic estimate of the inventory of radionuclides at the time of disposal would result. Table 8 presents a summary of the assumed time periods between reactor shutdown and disposal for the naval reactors dumped in the Kara Sea. Summarized for each disposal site is the disposal date, the number of discarded naval reactors and their associated ship identification number, the minimum decay time, and the best estimate decay time. With the exception of the two naval reactors that were discarded in Stepovoy Inlet in 1981, the minimum decay times were based on the

Yablokov Commission finding of a minimum period of one year between reactor shutdown and disposal. The two naval reactors discarded in Stepovoy Inlet were earlier identified with the K-27, an assumed November class submarine that suffered a reactor accident on May 24, 1968. As such their minimum decay time was established at thirteen years.

The best estimate decay time for each submarine whose discarded naval reactors contained SNF was assumed to be the time period, in whole years, between their associated accident and disposal dates. For those submarines whose discarded naval reactors are without SNF, the best estimate decay time was arbitrarily established at one year. In the case of the *Lenin*, whose reactor accident was reported to have occurred either early or late in 1966, the best estimate decay time was established at two years.

Table 9 presents a summary of the estimated activity in the SNF at the time of disposal. Summarized for each of the selected actinides and fission products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the selected actinides, the radionuclide and disposal site with the greatest activity are ^{241}Pu and Tsivolka Inlet, the location of the *Lenin* remnants, respectively. With respect to the selected fission products, the radionuclides with greatest activity are ^{147}Pm, ^{137}Cs, and^{90}Sr, respectively. The disposal sites with greatest total activity are Abrosimov Inlet and Tsivolka Inlet, respectively. Overall, for the time of disposal, the inventories are estimated at 17 to 66 kCi of actinides plus daughters and 1,695 to 4,782 kCi of fission products. The later range in activity compares favorably with the Yablokov Commission finding of 2,300 kCi of fission products.

Table 10 presents a summary of the estimated radioactivity for selected activation products in reactor components and primary system corrosion products at the time of disposal. Summarized for each of the selected activation products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the reactor components, the radionuclide and disposal site with greatest activity are ^{55}Fe and Abrosimov Inlet, respectively. Since the radioactivity in the reactor components and primary system corrosion products at a given disposal site is simply a function of the number of reactors discarded, Abrosimov Inlet is the expected site of greatest activity. Overall, for the time of disposal, the inventories are estimated at 917 to 1,127 kCi of activation products in the reactor components and 1.4 to 1.6 kCi of activation products in the primary system corrosion products. Of the 917 to 1,127 kCi of activation products in the reactor components, 161 to 184 kCi are associated with the ^{60}Co inventory in the 16 discarded naval reactors. On a per-reactor basis, the estimated ^{60}Co inventory in the reactor components is in excellent agreement with the Yablokov Commission finding of 100 kCi in the reactor components of ten naval reactors.

Table 11 presents a summary of the estimated radioactivity in the SNF at the present time (1993). Summarized for each of the selected actinides and fission products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the selected actinides, the radionuclide and disposal site with the greatest activity remain ^{241}Pu and Tsivolka Inlet, respectively. With respect to the selected fission products, the radionuclides with greatest activity are now ^{137}Cs and ^{90}Sr, respectively. The disposal sites with greatest total activity are now Abrosimov Inlet and Stepovoy Inlet, respectively. Overall, for the present time (1993), the inventories.are estimated at 6 to 24 kCi of actinides plus daughters and 492 to 540 kCi of fission products.

Table 12 presents a summary of the estimated radioactivity for selected activation products in reactor components and primary system corrosion products at the present time (1993). Summarized for each of the selected activation products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the reactor components, the radionuclides with greatest activity are ^{63}Ni at Abrosimov Inlet and ^{55}Fe at Techeniye Inlet, while the disposal site of greatest activity is now Techeniye Inlet. With respect to the primary system corrosion products, the radionuclide and disposal site with greatest activity are ^{60}Co and Techeniye Inlet, respectively. That Abrosimov Inlet is no longer the site of greatest activity is not surprising. While the radioactivity in the reactor components and primary system corrosion products at a given disposal site remains a simple function of the number of reactors discarded, when radioactive decay of the activation products is considered, Techeniye Inlet becomes the expected site of greatest activity. Overall, for the present time (1993), the inventories are estimated at 125 to 126 kCi of activation products in the reactor components and 0.16 to 0.17 kCi of activation products in the primary system corrosion products.

Table 13 presents a summary of the estimated radioactivity in the SNF at twenty years hence (2013). Summarized for each of the selected actinides and fission products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the selected actinides, the radionuclide and disposal site with the greatest activity remain ^{241}Pu and Tsivolka Inlet, respectively. With respect to the selected fission products, the radionuclides with greatest activity remain ^{137}Cs and ^{90}Sr, respectively. The disposal sites with greatest total activity remain Abrosimov Inlet and Stepovoy Inlet, respectively. Overall, for twenty years hence (2013), the inventories are estimated at 3 to 12 kCi of actinides plus daughters and 303 to 333 kCi of fission products.

Table 14 presents a summary of the estimated radioactivity for selected activation products in reactor components and primary system corrosion products at twenty years hence (2013). Summarized for each of the selected activation products are the minimum and maximum in radioactivity associated with the five disposal sites. With respect to the reactor components, the radionuclide with the greatest activity remains ^{63}Ni, while the disposal site of greatest activity is once again Abrosimov Inlet. With respect to the primary system corrosion products, the radionuclide and disposal site with greatest activity remain ^{60}Co and Techeniye Inlet, respectively. That Abrosimov Inlet and Techeniye Inlet are now the sites of greatest activity for the reactor components and primary system corrosion products, respectively, is not surprising. While the radioactivity in the reactor components and primary system corrosion products at a given disposal site remains a simple function of the number of reactors discarded, when radioactive decay of the activation products is considered, both Abrosimov Inlet and Techeniye Inlet become the expected sites of greatest activity. Overall, for twenty years hence (2013), the inventories are estimated at 63.5 to 64 kCi of activation products in the reactor components and 0.014 to 0.015 kCi of activation products in the primary system corrosion products. .

The figures that follow depict the inventories of selected radionuclides as a function of time. The time period of interest is that from the date of first disposal to the present time (1993). In preparing these graphical presentations of the time-dependent radionuclide inventory estimates, the following convention was adopted.

Reactor cores:

○ = Submarine reactors at 10% ^{235}U and *Lenin* reactor at 4.6% ^{235}U - minimum decay time

● = Submarine reactors at 36% ^{235}U and *Lenin* reactor at 6.4% ^{235}U - minimum decay time

□ = Submarine reactors at 10% ^{235}U and *Lenin* reactor at 4.6% ^{235}U - best estimate decay time

■ = Submarine reactors at 36% ^{235}U and *Lenin* reactor at 6.4% ^{235}U - best estimate decay time

◇ = Submarine reactors at 10% ^{235}U and *Lenin* reactor at 6.4% ^{235}U - minimum decay time

◆ = Submarine reactors at 36% ^{235}U and *Lenin* reactor at 4.6% ^{235}U - minimum decay time

x = Submarine reactors at 10% ^{235}U and *Lenin* reactor at 6.4% ^{235}U - best estimate decay time

Reactor components:

▼ = Minimum decay time

▵ = Best estimate decay time

Figures 1 - 4 depict the results of the activity estimates for selected actinides in the discarded naval reactors containing SNF. Figures 5 - 14 depict the results of the activity estimates for selected fission products in the discarded naval reactors containing SNF. Activity estimates for selected activation products in the reactor components are depicted in Figures 15 - 19. Total activity estimates for the actinides, fission products, and activation products in the reactor components are depicted in Figures 20 - 22, respectively.

Conclusions

Considering the uncertainties associated with certain of the analytical model parameters and in the times between reactor shutdown and disposal, the estimates presented herein agree quite favorably with the Yablokov findings for the time of disposal.

At the present time (1993), even if one assumes that the actinides are underestimated by a factor of two, the inventories of actinides and fission products in the SNF and the inventories of activation products in reactor components and primary system corrosion products are estimated to be no greater than 47 kCi, 540 kCi, 126 kCi, and 0.17 kCi, respectively. Total inventory is estimated at less than 713 kCi.

At twenty years hence (2013), even if one continues to assume that the actinides are underestimated by a factor of two, the inventories of actinides and fission products in the SNF and the inventories of and activation products in reactor components and primary system corrosion products are estimated to be no greater than 23 kCi, 333 kCi, 64 kCi and 0.015 kCi, respectively. Total inventory is estimated at less than 420 kCi.

Based upon the estimated inventory of radionuclides, Abrosimov Inlet and Stepovoy Inlet remain the disposal sites with the greatest total activity, respectively.

Recommendations

Improvements may be made in the calculation of the estimated inventory of radionuclides. To achieve the improvements desired, the following steps are recommended: (1) obtain definitive information on the time period between the shutdown date of each reactor and the date of its disposal, (2) validate the core histories of all discarded naval reactors containing SNF, (3) obtain definitive information on the materials of construction and geometry of a typical fuel assembly, and (4) obtain definitive information on the neutron energy spectrum in the reactors involved.

Acknowledgements

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References

1. A.V. Yablokov, et. al., *Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territory of the Russian Federation*, Office of the President of the Russian Federation, Moscow (1993), pp. 20-41.
2. J. Handler, *Trip Report: Greenpeace Visit to Moscow and Russian Far East, July - November 1993, Subject: Russian Navy Nuclear Submarine Safety, Construction, Defense Conversion, Decommissioning, and Nuclear Waste Disposal Problems*, Greenpeace, Washington, DC (February 1993).
3. K. L. Sjoeblom, "Ocean Disposal of Radioactive Waste: (i) The IAEA 'Definition and Recommendations;' (ii) The IAEA Data Base of Sea Disposal of Radioactive Waste," International Meeting on Assessment of Actual and Potential Consequences of Dumping of Radioactive Waste into Arctic Seas, Oslo, Norway, February 1 - 5, 1993.
4. V. O. Eriksen, *Sunken Nuclear Submarines*, Norwegian University Press, Oslo, Norway (1990), p. 167.
5. *Proceedings of the Third International Conference on the Peaceful Uses of Atomic Energy*, Volume 6, United Nations, New York (1965), p. 469.
6. Morokhov, *Atomic Energy: 20 Years*, Atomic Energy Publishing House, Moscow (1974), p. 148.
7. *Warships of the Soviet Navy*, J. E. Moore, Ed., Jane's Information Group Limited, Surrey, United Kingdom (1981).
8. *Naval Institute Guide to the Soviet Navy*, N. Polmar, Ed., Naval Institute Press, Annapolis, Maryland (1991), pp. 91 - 134.

9. *Soviet Submarines 1945 to the Present*, J. Jordan, Ed., Arms and Armour (1982).

10. *Jane's Fighting Ships*, R. Sharpe, Ed., Jane's Information Group Limited, Surrey, United Kingdom (1992).

11. V. O. Eriksen, *Sunken Nuclear Submarines*, Norwegian University Press, Oslo, Norway (1990), p. 67.

12. O. Bukharin, *The Threat of Nuclear Terrorism and the Physical Security of Nuclear Installations and Materials in the Former Soviet Union*, Center for Russian and Eurasian Studies, Monterey Institute for International Studies, Monterey, California (August 1992), p. 5.

13. A. G. Croff, *ORIGEN2 - A Revised and Updated Version of the Oak Ridge Isotope Generation and Depletion Code*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, ORNL-5621 (July 1980).

14. O. W. Herman and R. M. Westfall, "ORIGEN-S: SCALE System Module to Calculate Fuel Depletion, Actinide Transmutation, Fission Product Buildup and Decay, and Associate Radiation Source Terms," *SCALE: A Modular Code system for Performing Standardized Computer Analyses for Licensing Evaluation*, Oak Ridge National Laboratory, Oak Ridge, Tennessee, NUREG/CR-0200, (ORNL/NUREG/CSD-2/R4), Volumes, I, II, and III (Draft, February 1990).

15. V. O. Erikson, *Sunken Nuclear Submarines*, Norwegian University Press, Oslo, Norway (1990), pp. 95 - 96.

16. House of Commons Defence Committee, "Decommissioning of Nuclear Submarines," 7th Report, Session 1988 - 1989, Her Majesty's Stationary Office, London (1990).

17. E. Browne and R. B. Firestone, *Table of Radioactive Isotopes*, V. S. Shirley, Ed. John Wiley & Sons, Inc., New York (1986).

18. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report No. 11, EPA-520/1-88020, September 1988.

Table 1. Yablokov Commission findings for the former Soviet Union naval reactors dumped in the Kara Sea.[1]

Disposal Site	Disposal Date	Naval Reactors Discarded	Reactors Containing SNF	Fission Product Activity (kCi)
Abrosimov Inlet	1965	2 (No. 285)	1	800
		2 (No. 901)	2	400
		2 (No. 254)	-	-
	1966	2 (No. 260)	-	-
Tsivolka Inlet	1967	3 (OK-150)	0.6*	100
Novaya Zemlya Depression	1972	1 (No. 421)	1	800
Stepovoy Inlet	1981	2 (No. 601)	2	200
Techeniye Inlet	1988	2 (No. 538)	-	-
Total		16	6.6	2,300

*The SNF was not contained in the naval reactor, but in a reinforced concrete and metal shell.

Table 2. Western estimates of the identities of the former Soviet Union submarines whose naval reactors were dumped in the Kara Sea.[2,3]

Submarine Identification	NATO Classification	Reactor Accident Date
K-3	November	June, 1962 September 8, 1967
K-5	Hotel/November	Mid-1960s
K-11	November	February 12, 1965
K-19	Hotel	July 4, 1961
K-22*	–	–
K-27	November	May 24, 1968
K-140	Yankee II	August 23, 1968

*No information is currently available in the open literature for this submarine.

Table 3. **Best estimate association of ship identification with the NATO classification of each submarine whose discarded naval reactors contained SNF.**

Disposal Date	Reactors Containing SNF	Submarine Identification	NATO Classification
1965	1 (No. 285)	K-3	November
	2 (No. 901)	K-19	Hotel
1972	1 (No. 421)	K-140	Yankee II
1981	2 (No. 601)	K-27	November

Table 4. Naval reactor core information for the former Soviet Union icebreaker *Lenin*.[5,6]

Number of assemblies per reactor: 219 ^{235}U enrichment range: 4.6% to 6.4%

	Core Histories		
Naval Reactor	^{235}U Loading (kg)	Operating Period (MW hours)	Effective Full Power Hours (hours)
1	80	560,000	8,600
2	76	550,000	8,500
3	129	660,000	10,000

Table 5. Summary of the basic data used to estimate the minimum quantity of U in the reactor fuel load for each former Soviet Union submarine whose discarded naval reactors contained SNF.

Parameter	Value Range	Value Assumed
November class SHP (10^3hp)[7,8]	30.0 - 35.0	32.5
Hotel class SHP (10^3hp)[8,9]	29.5 - 30.0	29.75
Yankee II class SHP (10^3hp)[7,8,10]	29.5 - 45.0	37.25
November class S_{max} (knots)[7,8]	28 - 30	29
Hotel class S_{max} (knots)[8,9]	23 - 26	24.5
Yankee II class S_{max} (knots)[7,8,10]	26.5 - 27	26.75
Propulsion efficiency, PE, (%)[11]	15 - 20	15
Hotel load, HL, (MW)	12 - 15	15
Number of reactors, N_R [8,9,10]	2	2
At-sea time, AST (d/y)	120	120
Core life, CL, (y)	5 - 7	7
^{235}U enrichment. E_U, (%) [12]	10 - 36	10 - 36

Table 6. Information used to predict the radionuclide inventory in the reactor components and primary system corrosion products in the former Soviet Union naval reactors dumped in the Kara Sea.[15,16]

		Activity (Ci)	
Nuclide	Half-life (y)	Reactor Components	Primary System Corrosion Products
^{60}Co	5.27	1.27×10^{4}	1.09×10^{2}
^{14}C	5,730	1.14×10^{1}	1.57×10^{-5}
^{63}Ni	100.1	5.22×10^{3}	2.61×10^{-1}
^{55}Fe	2.73	6.11×10^{4}	1.94×10^{0}
^{59}Ni	75,000	4.68×10^{1}	1.37×10^{-5}
Total		7.91×10^{4}	1.11×10^{2}

Table 7. Characteristics of the selected actinide, fission product, and activation product radionuclides in the inventory.

Nuclide	Half-Life (y)	Radiation Type	Average Energy[17] (MeV)	Annual Limit on Intake[18] (μCi)
Actinides				
^{239}Pu	24,110	α	5.10	0.8
^{240}Pu	6,563	α	5.16	0.8
^{241}Am	432.7	α	5.48	0.8
		γ	0.0287	
^{238}Pu	87.7	α	5.49	0.9
		γ	0.00176	
^{241}Pu	14.4	β	0.0052	40
Fission Products				
^{129}I	15,700,000	β	0.0415	5
		γ	0.0248	
^{90}Sr	28.5	β	0.196	30
^{134}Cs	2.06	γ	1.55	70
		β	0.157	
^{137}Cs	30.0	γ	0.566	100
		β	0.188	
^{154}Eu	8.8	γ	1.25	500
		β	0.227	
^{125}Sb	2.73	γ	0.443	2,000
		β	0.086	
^{147}Pm	2.62	β	0.062	4,000
^{155}Eu	4.96	β	0.0471	4,000
		γ	0.063	
^{99}Tc	213,000	β	0.085	4,000
^{151}Sm	90	β	0.125	10,000
Activation Products				
^{60}Co	5.27	γ	2.50	200
		β	0.096	
^{14}C	5,730	β	0.0495	2,000
^{63}Ni	100.1	β	0.0171	9,000
^{55}Fe	2.73	EC	0.0038	9,000
		γ	0.00163	
^{59}Ni	75,000	EC	0.0041	20,000
		γ	0.00232	

Table 8. Assumed time periods between reactor shutdown and disposal for the former Soviet Union naval reactors dumped in the Kara Sea.

Disposal Site	Disposal Date	Naval Reactors Discarded	Minimum Decay Time (y)	Best Estimate Decay Time (y)
Abrosimov Inlet	1965	2 (No. 285)	1.0	3.0
		2 (No. 901)	1.0	4.0
		2 (No. 254)	1.0	1.0
	1966	2 (No. 260)	1.0	1.0
Tsivolka Inlet	1967	3 (OK-150)	1.0	2.0
Novaya Zemlya Depression	1972	1 (No. 421)	1.0	4.0
Stepovoy Inlet	1981	2 (No. 601)	13.0	13.0
Techeniye Inlet	1988	2 (No. 538)	1.0	1.0

Table 9. Estimated radioactivity in the SNF at the time of disposal for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Actinides												
$^{239+240}$Pu	94	474	343	374	33	167	55	280	--	--	526	1,295
^{241}Am	1	149	35	98	1	58	4	190	--	--	41	495
^{238}Pu	23	320	125	180	9	123	10	135	--	--	166	758
^{241}Pu	449	22,000	15,500	26,900	168	8,210	140	6,250	--	--	16,257	63,360
Subtotal	567	22,943	16,003	27,552	210	8,558	209	6,855	--	--	16,990	65,908
All	573	23,100	16,100	27,800	212	8,640	212	6,860	--	--	17,097	66,400
Fission Products												
^{129}I	0.02	0.03	0.01	0.01	0.009	0.009	0.01	0.02	--	--	0.06	0.06
^{90}Sr	89,900	100,000	34,300	44,100	31,400	35,200	42,800	44,500	--	--	198,400	223,800
^{134}Cs	3,930	36,000	11,500	18,200	1,320	13,400	90	328	--	--	16,840	67,928
^{137}Cs	97,900	104,000	40,000	48,900	34,300	36,700	46,700	46,700	--	--	218,900	236,300
^{154}Eu	1,450	1,810	707	943	532	678	347	347	--	--	3,036	3,778
^{125}Sb	2,500	6,620	3,160	4,120	813	2,340	142	192	--	--	6,615	13,272
^{147}Pm	125,000	253,000	69,100	115,000	40,100	88,700	5,350	6,320	--	--	239,550	463,020
^{155}Eu	1,570	2,430	1,020	1,260	527	850	253	275	--	--	3,370	4,815
^{99}Tc	15	15	6	7	5	5	9	9	--	--	34	36
^{151}Sm	852	1,690	332	464	287	584	513	950	--	--	1,984	3,688
Subtotal	323,117	505,565	160,125	232,994	109,284	178,457	96,203	99,621	--	--	688,729	1,016,637
All	663,000	2,300,000	632,000	1,480,000	213,000	811,000	187,000	191,000	--	--	1,695,000	4,782,000

Table 10. Estimated radioactivity of selected activation products in the reactor components and primary system corrosion products at the time of disposal for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Reactor Components												
^{60}Co	87,700	102,000	33,500	38,200	8,580	12,700	5,250	5,250	25,500	25,500	160,530	183,650
^{14}C	92	92	34	34	11	11	23	23	23	23	183	183
^{63}Ni	41,300	41,600	15,500	15,600	5,110	5,220	9,600	9,600	10,400	10,400	81,910	82,420
^{55}Fe	374,500	488,000	142,000	183,000	28,500	61,100	5,810	5,810	122,000	122,000	672,810	859,910
^{59}Ni	374	374	140	140	47	47	94	94	94	94	749	749
All	503,966	632,066	191,174	236,974	42,248	79,078	20,777	20,777	158,017	158,017	916,182	1,126,912
Primary System Corrosion Products												
^{60}Co	748	868	286	326	73	109	45	45	217	217	1,369	1,565
^{14}C	0.0001	0.0001	0.00005	0.00005	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.0003	0.0003
^{63}Ni	2	2	1	1	0.3	0.3	0.5	0.5	1	1	4	4
^{55}Fe	12	15	5	6	1	2	0	0	4	4	21	27
^{59}Ni	0.01	0.01	0.004	0.004	0.001	0.001	0.003	0.003	0.003	0.003	0.02	0.02
All	762	886	291	333	74	111	45	45	221	221	1,394	1,596

Table 11. Estimated radioactivity in the SNF at the present time (1993) for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Actinides												
$^{239+240}$Pu	94	474	343	374	33	167	55	280	--	--	526	1,295
^{241}Am	14	605	412	688	5	204	6	277	--	--	436	1,774
^{238}Pu	18	258	102	148	7	105	9	123	--	--	136	634
^{241}Pu	117	5,710	4,450	7,690	61	2,990	79	3,510	--	--	4,707	19,900
Subtotal	243	7,047	5,307	8,900	106	3,466	149	4,190	--	--	5,805	23,603
All	247	7,050	5,310	8,900	108	3,450	152	4,190	--	--	5,817	23,590
Fission Products												
^{129}I	0.02	0.03	0.01	0.01	0.009	0.009	0.01	0.02	--	--	0.06	0.06
^{90}Sr	46,200	51,400	18,500	23,700	19,000	21,400	32,100	33,400	--	--	115,800	129,900
^{134}Cs	0.3	3	2	3	1	12	2	6	--	--	5	23
^{137}Cs	51,300	54,600	21,900	26,800	21,100	22,600	35,400	35,400	--	--	129,700	139,400
^{154}Eu	152	190	87	116	98	125	132	132	--	--	469	563
^{125}Sb	2	6	5	6	4	12	7	9	--	--	18	33
^{147}Pm	63	155	72	119	128	345	225	365	--	--	488	984
^{155}Eu	31	49	27	33	28	45	47	51	--	--	133	178
^{99}Tc	15	15	6	7	5	5	9	9	--	--	34	36
^{151}Sm	686	1,360	271	380	244	496	468	866	--	--	1,669	3,102
Subtotal	98,449	107,777	40,869	51,164	40,608	45,040	68,389	70,238	--	--	248,316	274,220
All	195,000	213,000	80,900	101,000	80,500	86,700	136,000	139,000	--	--	492,400	539,700

Table 12. Estimated radioactivity of selected activation products in the reactor components and primary system corrosion products at the present time (1993) for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Reactor Components												
^{60}Co	2,297	2,654	1,100	1,250	542	804	1,080	1,080	13,200	13,200	18,219	18,988
^{14}C	91	91	34	34	11	11	23	23	23	23	182	182
^{63}Ni	34,140	34,420	13,000	13,100	4,420	4,510	8,480	8,480	10,100	10,100	70,140	70,610
^{55}Fe	336	429	193	249	138	296	276	276	34,300	34,300	35,243	35,550
^{59}Ni	374	374	140	140	47	47	94	94	94	94	749	749
All	37,238	37,968	14,467	14,773	5,158	5,668	9,953	9,953	57,717	57,717	124,533	126,079
Primary System Corrosion Products												
^{60}Co	20	23	9	11	5	7	9	9	113	113	156	162
^{14}C	0.0001	0.0001	0.00005	0.00005	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.0002	0.0002
^{63}Ni	1.7	1.7	0.6	0.7	0.2	0.2	0.4	0.4	0.5	0.5	3.5	3.5
^{55}Fe	0.01	0.01	0.006	0.008	0.004	0.009	0.009	0.009	1.1	1.1	1.1	1.1
^{59}Ni	0.01	0.01	0.004	0.004	0.001	0.001	0.003	0.003	0.003	0.003	0.02	0.02
All	21	24	10	11	5	7	10	10	115	115	161	167

Table 13. Estimated radioactivity in the SNF at twenty years hence (2013) for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Actinides												
$^{239+240}$Pu	94	474	343	374	33	167	55	280	--	--	525	1,294
^{241}Am	16	701	489	822	6	258	8	339	--	--	518	2,120
^{238}Pu	15	220	87	126	6	90	8	105	--	--	116	541
^{241}Pu	45	2,181	1,700	2,937	23	1,142	30	1,341	--	--	1,798	7,601
Subtotal	170	3,576	2,618	4,259	68	1,656	101	2,065	--	--	2,957	11,556
All	170	3,576	2,618	4,259	68	1,656	101	2,065	--	--	2,957	11,556
Fission Products												
^{129}I	0.02	0.03	0.01	0.01	0.009	0.009	0.01	0.02	--	--	0.06	0.06
^{90}Sr	28,408	31,605	11,375	14,573	11,683	13,159	19,738	20,537	--	--	71,204	79,874
^{134}Cs	0.0004	0.004	0.002	0.003	0.001	0.01	0.002	0.007	--	--	0.01	0.03
^{137}Cs	32,320	34,399	13,797	16,885	13,293	14,239	22,303	22,303	--	--	81,714	87,825
^{154}Eu	31	39	18	24	20	26	27	27	--	--	97	117
^{125}Sb	0.01	0.04	0.03	0.04	0.03	0.08	0.04	0.06	--	--	0.1	0.2
^{147}Pm	0.3	0.8	0.4	0.6	0.6	1.7	1.1	1.8	--	--	2.5	5.0
^{155}Eu	2	3	2	2	2	3	3	3	--	--	8	11
^{99}Tc	15	15	6	7	5	5	9	9	--	--	34	36
^{151}Sm	588	1,166	232	326	209	425	401	742	--	--	1,431	2,659
Subtotal	61,364	67,229	25,431	31,817	25,213	27,858	42,482	43,624	--	--	154.491	170,527
All	120,344	131,372	49,857	62,361	49,471	54,485	83,316	85,257	--	--	302,988	333,475

Table 14. Estimated radioactivity of selected activation products in the reactor components and primary system corrosion products at twenty years hence (2013) for the former Soviet Union naval reactors dumped in the Kara Sea.

	Disposal site activity range (Ci)											
Nuclide	Abrosimov Inlet		Tsivolka Inlet		Novaya Zemlya Depression		Stepovoy Inlet		Techeniye Inlet		All sites	
Reactor Components												
^{60}Co	166	191	79	90	39	58	78	78	951	951	1,313	1,369
^{14}C	91	91	34	34	11	11	23	23	23	23	182	182
^{63}Ni	29,726	29,969	11,319	11,406	3,848	3,927	7,384	7,384	8,794	8,794	61,071	61,480
^{55}Fe	2	3	1	2	1	2	2	2	214	214	220	222
^{59}Ni	374	374	140	140	47	47	94	94	94	94	749	749
All	30,358	30,628	11,573	11,672	3,946	4,045	7,580	7,580	10,076	10,076	63,534	64,001
Primary System Corrosion Products												
^{60}Co	1.4	1.6	0.7	0.8	0.3	0.5	0.7	0.7	8.1	8.1	11.2	11.7
^{14}C	0.0001	0.0001	0.00005	0.00005	0.00002	0.00002	0.00003	0.00003	0.00003	0.00003	0.0002	0.0002
^{63}Ni	1.5	1.5	0.6	0.6	0.2	0.2	0.4	0.4	0.4	0.4	3.1	3.1
^{55}Fe	0.00007	0.00008	0.00004	0.00005	0.00003	0.00006	0.00005	0.00005	0.007	0.007	0.007	0.007
^{59}Ni	0.01	0.01	0.004	0.004	0.001	0.001	0.003	0.003	0.003	0.003	0.02	0.02
All	2.9	3.1	1.2	1.3	0.5	0.7	1.1	1.1	8.6	8.6	14.3	14.8

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Figure 1. $^{239+240}$Pu inventory in naval reactor cores dumped in the Kara Sea.
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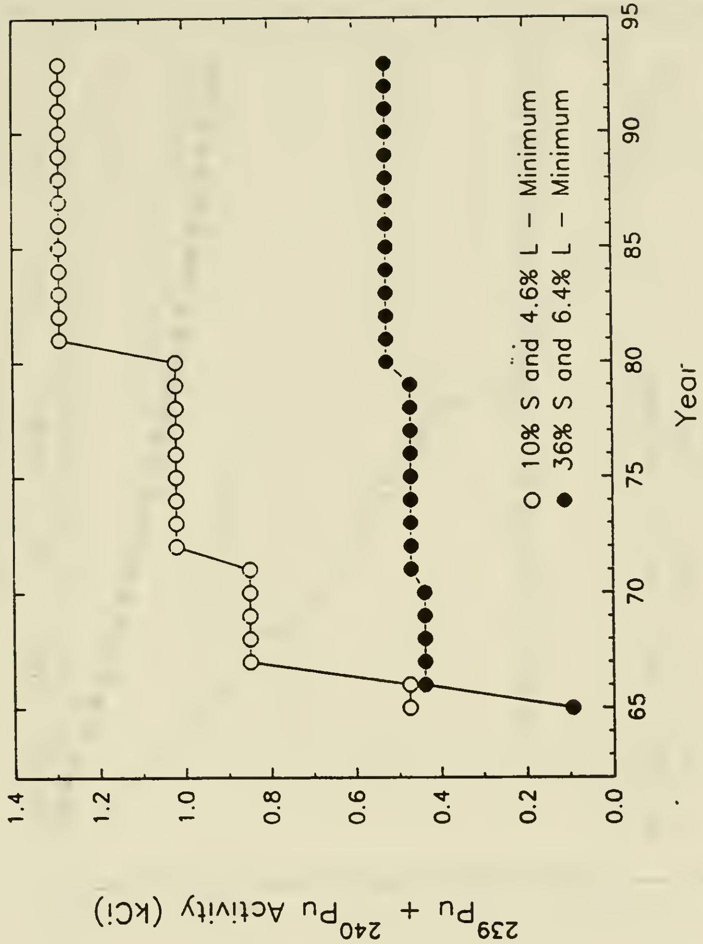
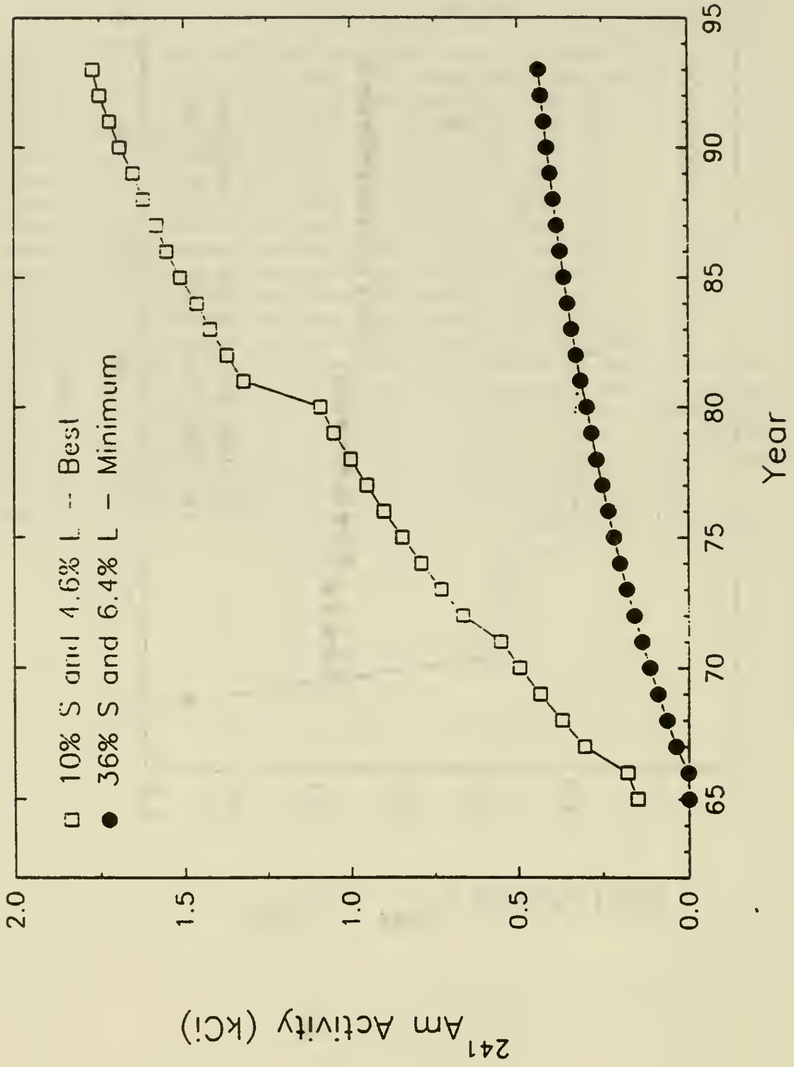
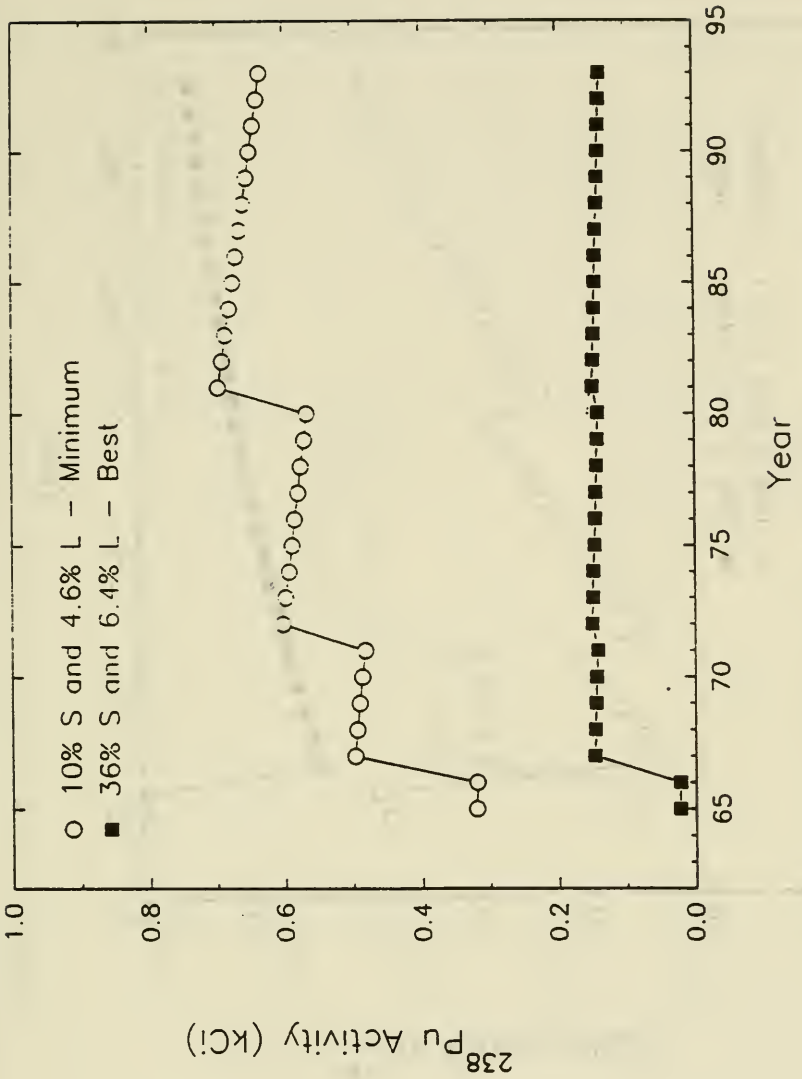
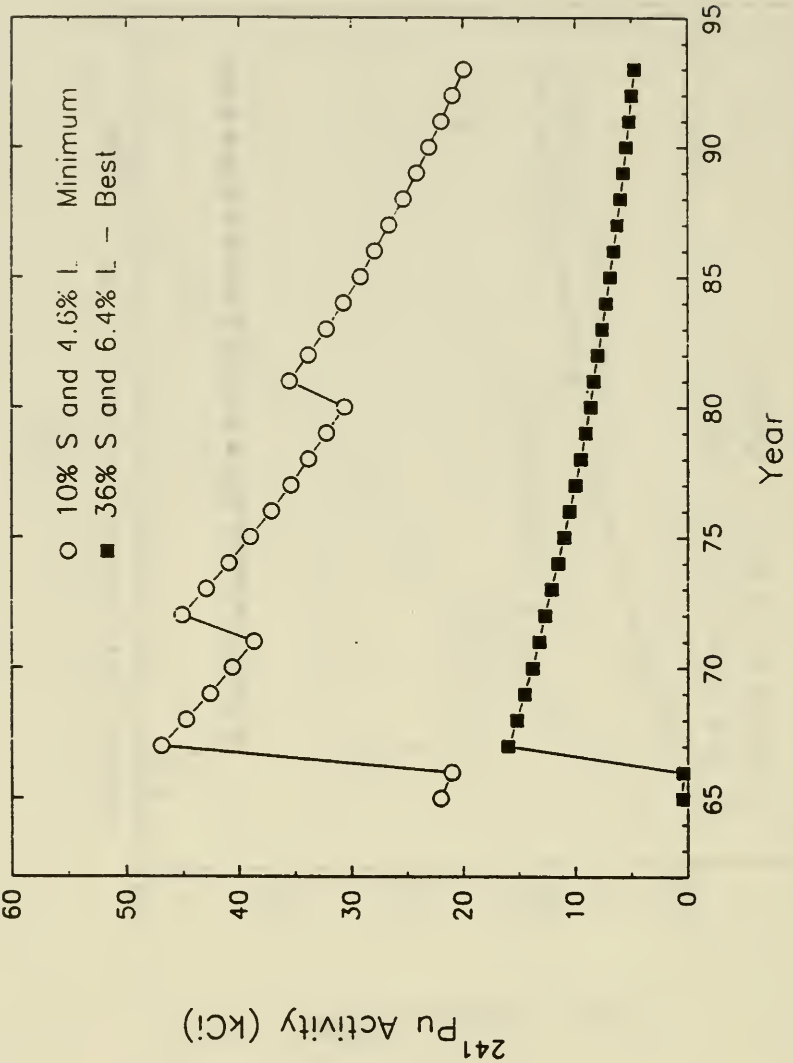


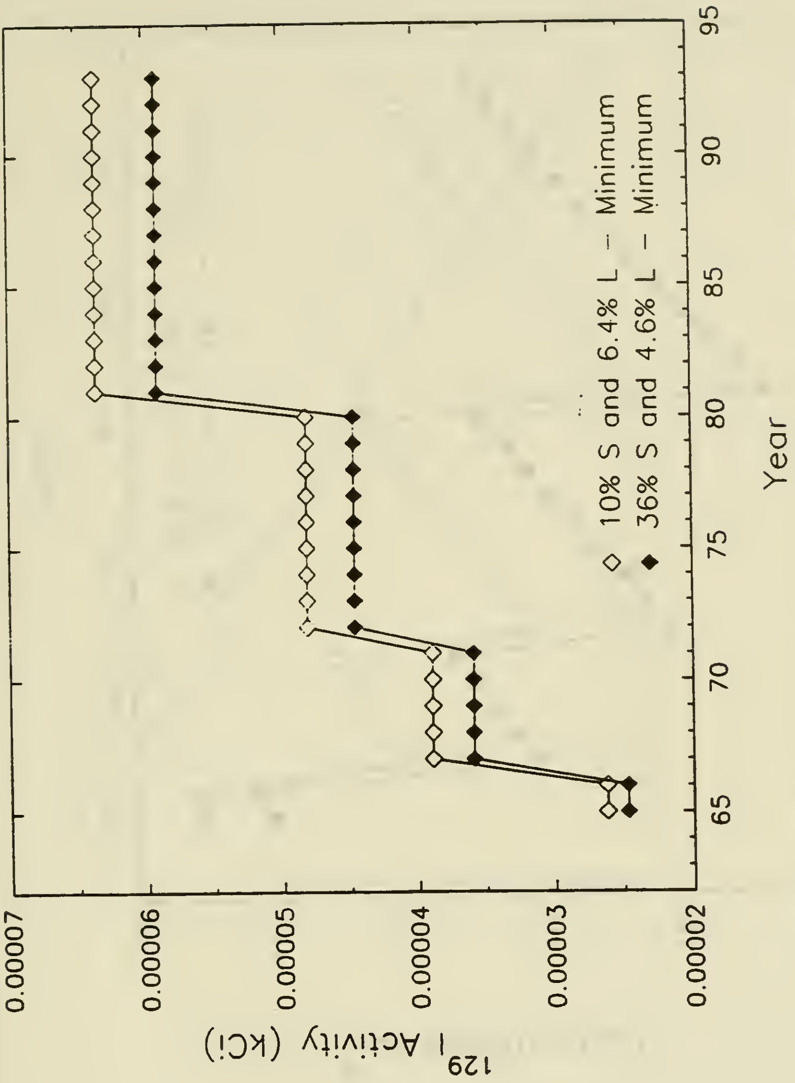
○ 10% S and 4.6% L – Minimum
● 36% S and 6.4% L – Minimum
Year
65
70
75
80
85
90
95
^{239}Pu + ^{240}Pu Activity (kCi)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

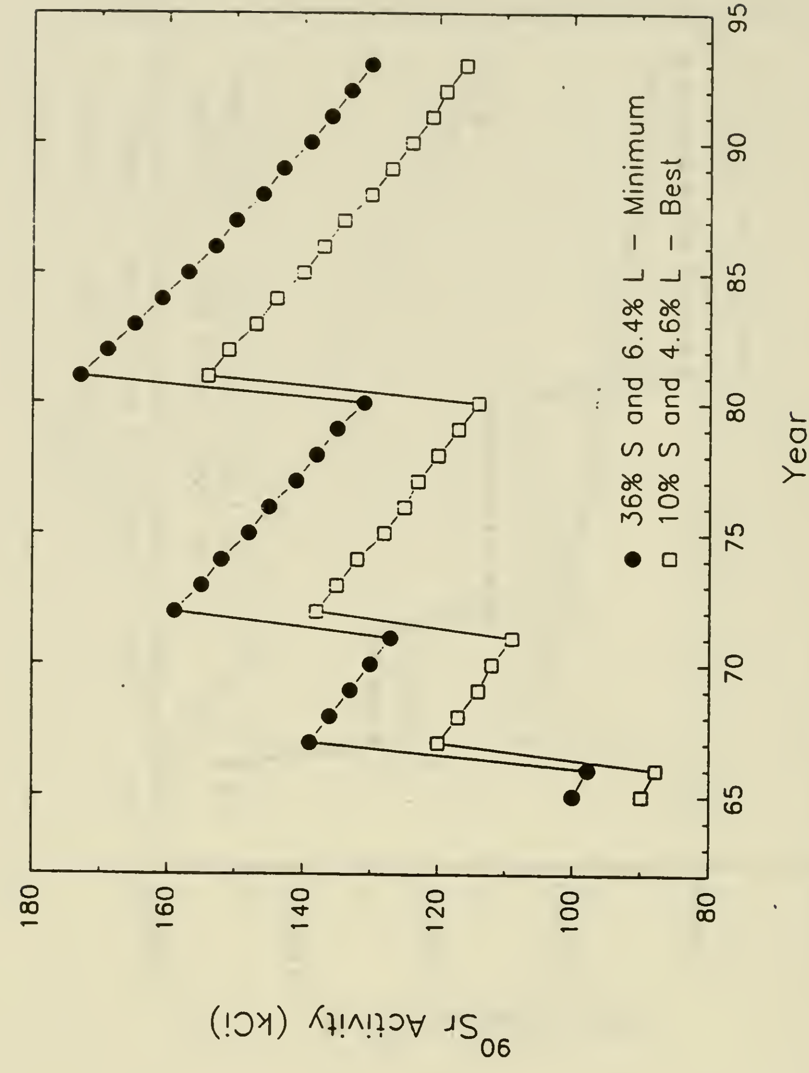


□ 10% S and 4.6% L -- Best
● 36% S and 6.4% L - Minimum
^{241}Am Activity (kCi)
0.0
0.5
1.0
1.5
2.0
Year
65
70
75
80
85
90
95

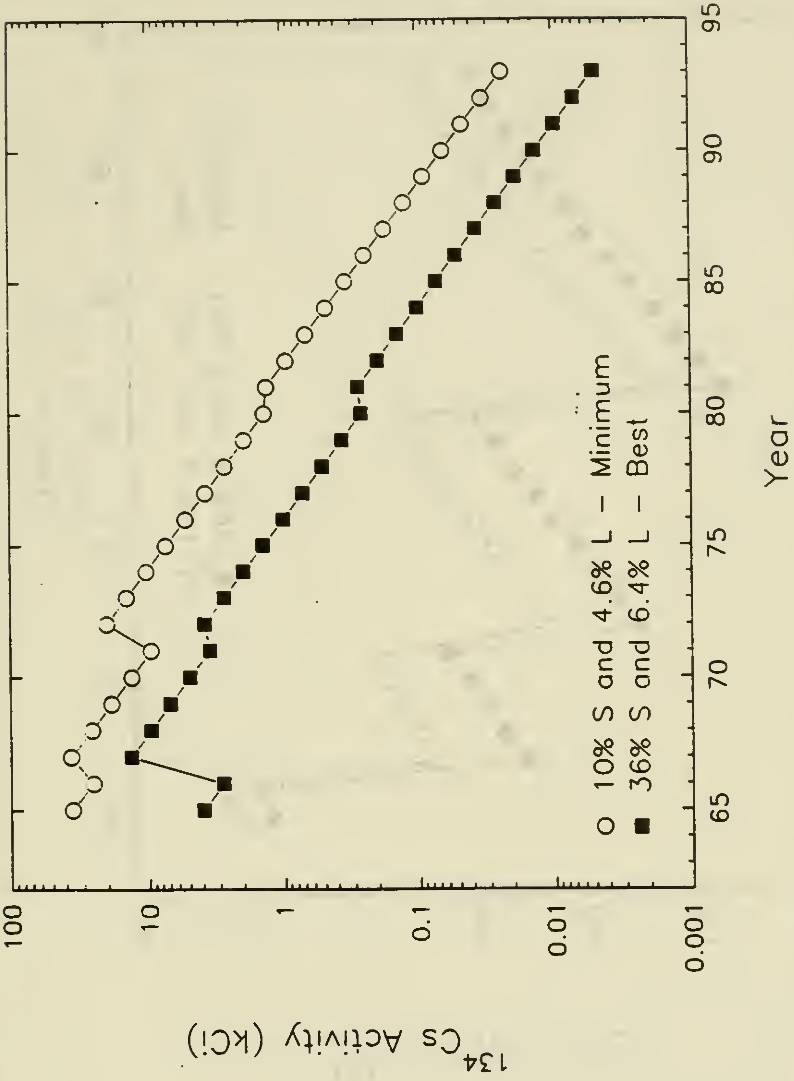

○ 10% S and 4.6% L – Minimum
■ 36% S and 6.4% L – Best
Year
65
70
75
80
85
90
95
^{238}Pu Activity (kCi)
0.0
0.2
0.4
0.6
0.8
1.0

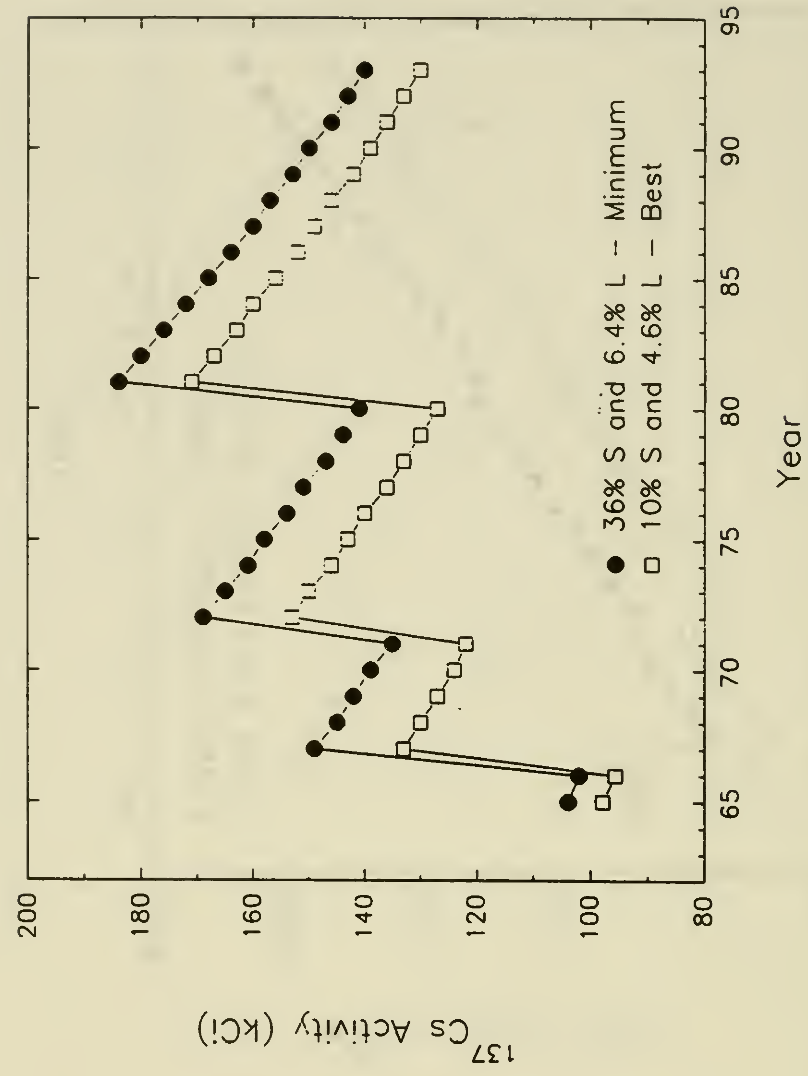

○ 10% S and 4.6% L – Minimum
■ 36% S and 6.4% L – Best
^{241}Pu Activity (kCi)
0
10
20
30
40
50
60
Year
65
70
75
80
85
90
95

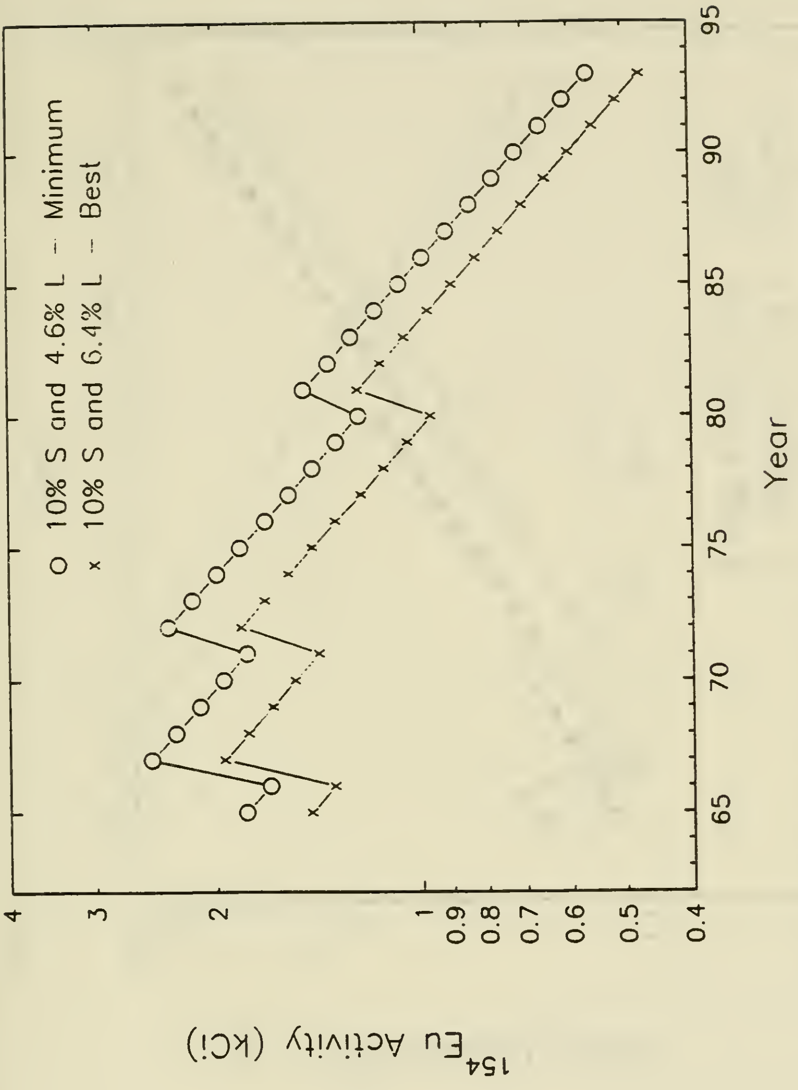

0.00007
0.00006
0.00005
0.00004
0.00003
0.00002
129I Activity (kCi)
65
70
75
80
85
90
95
Year
◇ 10% S and 6.4% L – Minimum
◆ 36% S and 4.6% L – Minimum

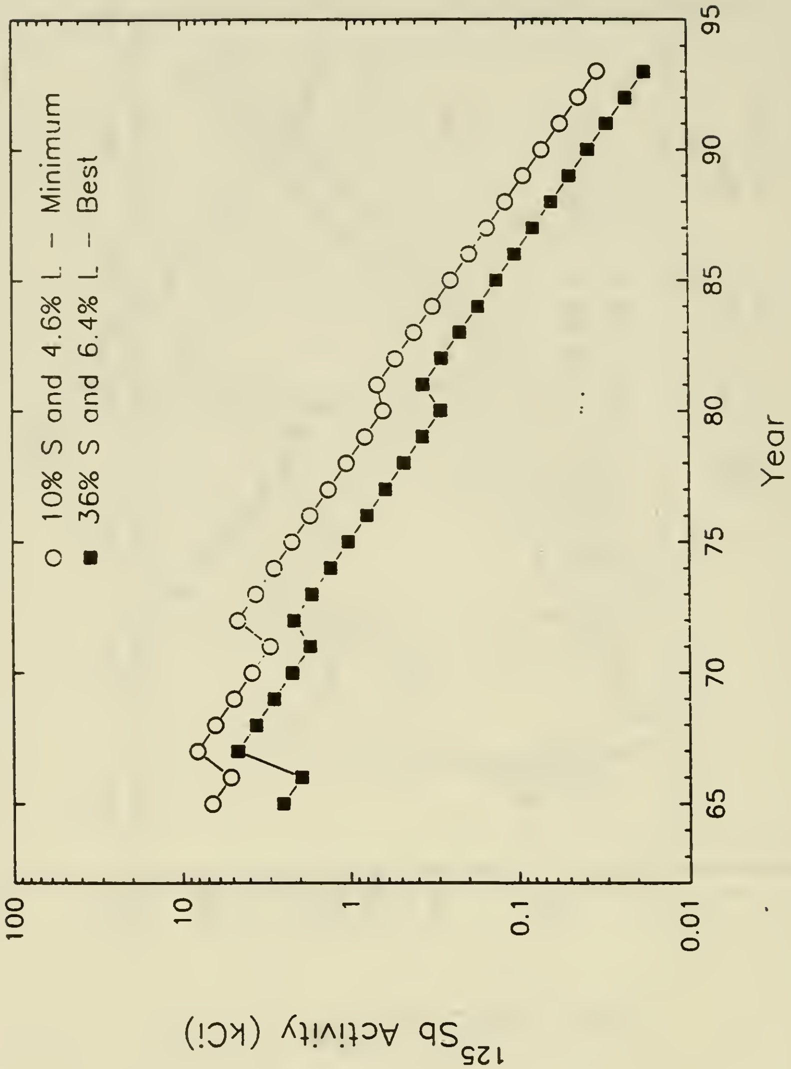


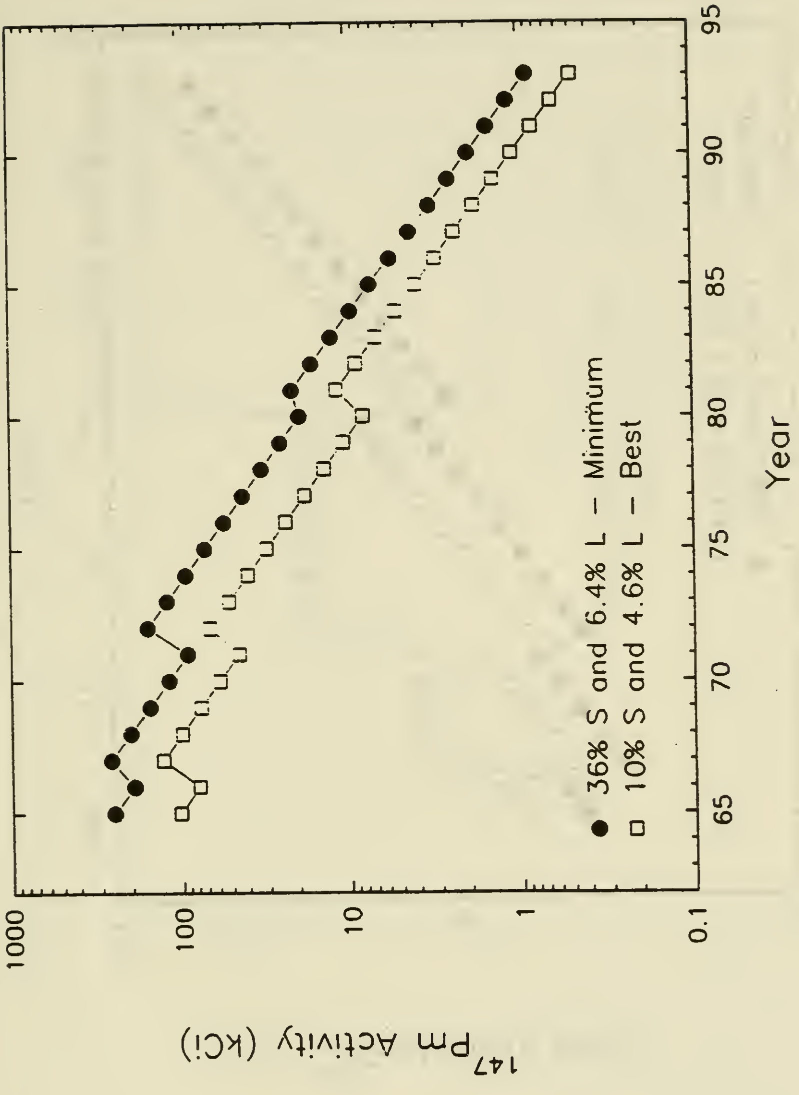
180
160
140
120
100
80
90Sr Activity (kCi)
65
70
75
80
85
90
95
Year
● 36% S and 6.4% L – Minimum
□ 10% S and 4.6% L – Best

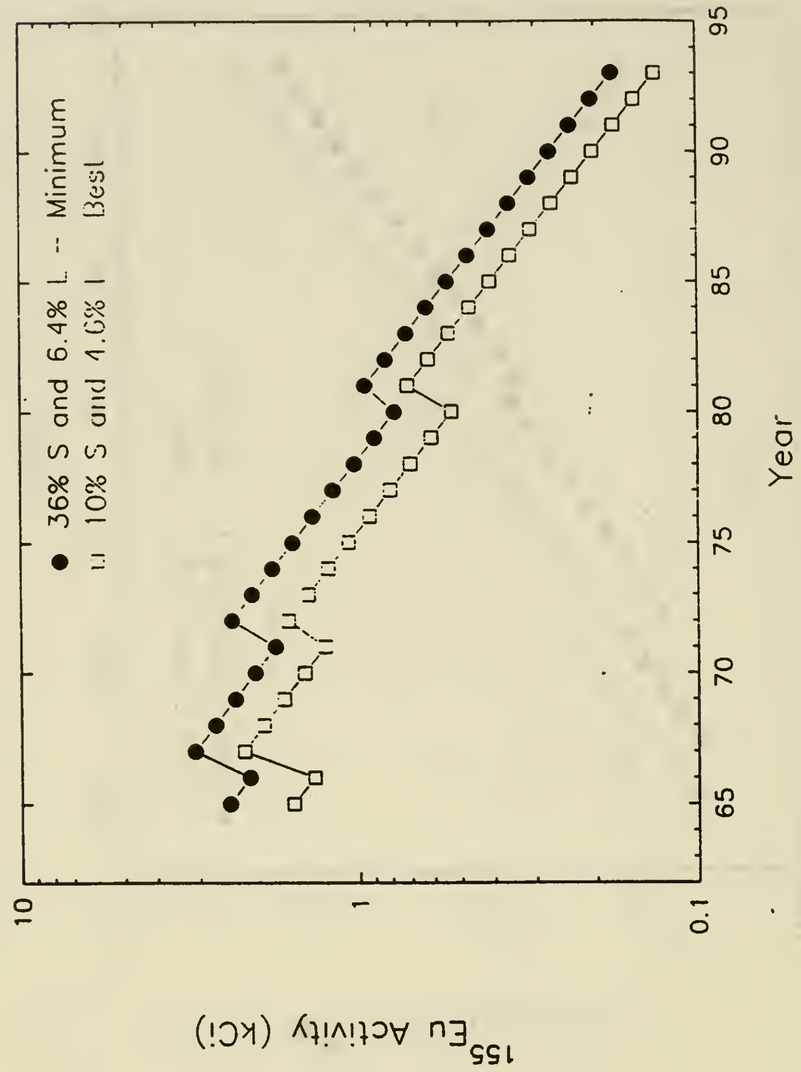

100
10
1
0.1
0.01
0.001
^{134}Cs Activity (kCi)
65
70
75
80
85
90
95
Year
○ 10% S and 4.6% L – Minimum
■ 36% S and 6.4% L – Best

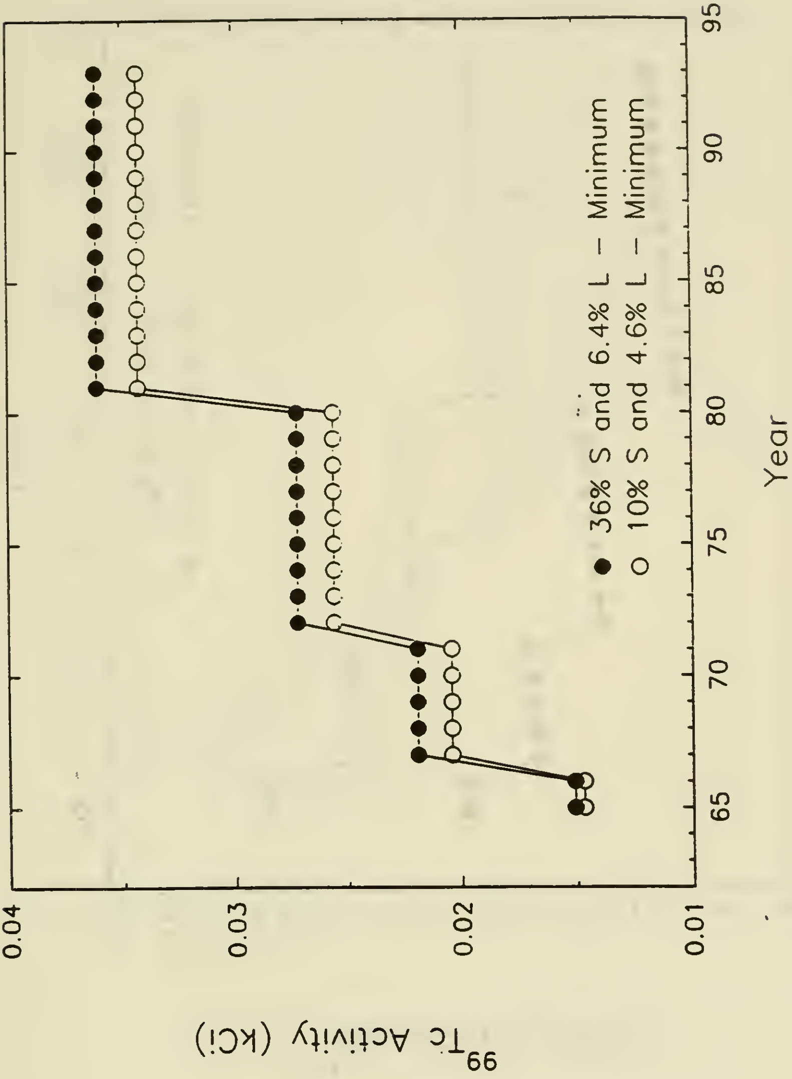

^{137}Cs Activity (kCi)
200
180
160
140
120
100
80
Year
65
70
75
80
85
90
95
● 36% S and 6.4% L – Minimum
□ 10% S and 4.6% L – Best


○ 10% S and 4.6% L – Minimum
× 10% S and 6.4% L – Best
Year
65
70
75
80
85
90
95
^{154}Eu Activity (kCi)
4
3
2
1
0.9
0.8
0.7
0.6
0.5
0.4

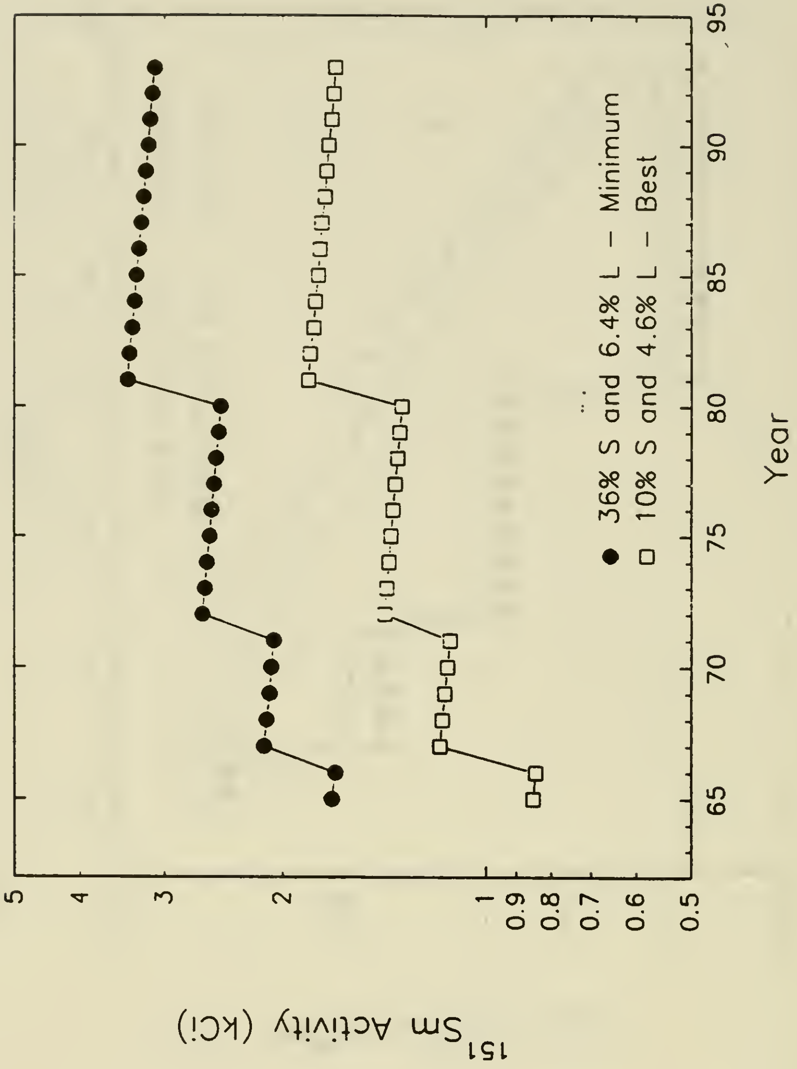

○ 10% S and 4.6% L – Minimum
■ 36% S and 6.4% L – Best
^{125}Sb Activity (kCi)
100
10
1
0.1
0.01
65
70
75
80
85
90
95
Year


^{147}Pm Activity (kCi)
1000
100
10
1
0.1
Year
65
70
75
80
85
90
95
● 36% S and 6.4% L – Minimum
□ 10% S and 4.6% L – Best

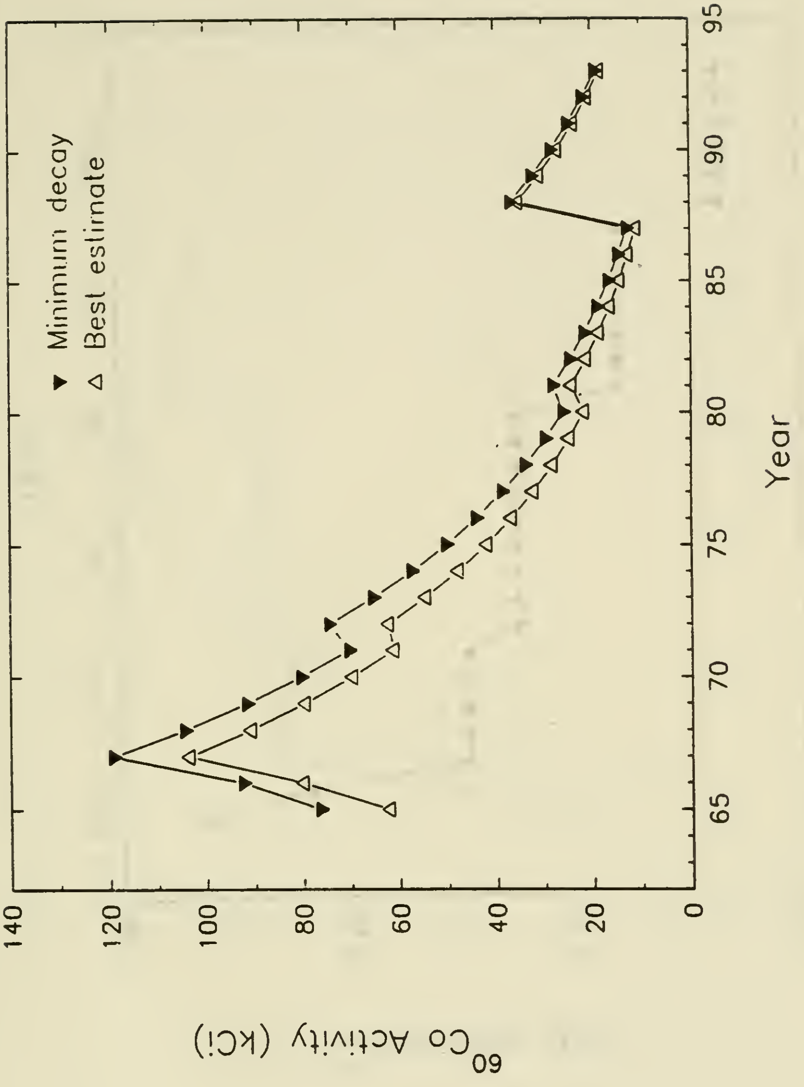

● 36% S and 6.4% L -- Minimum
□ 10% S and 4.6% I Best
^{155}Eu Activity (kCi)
10
1
0.1
65
70
75
80
85
90
95
Year

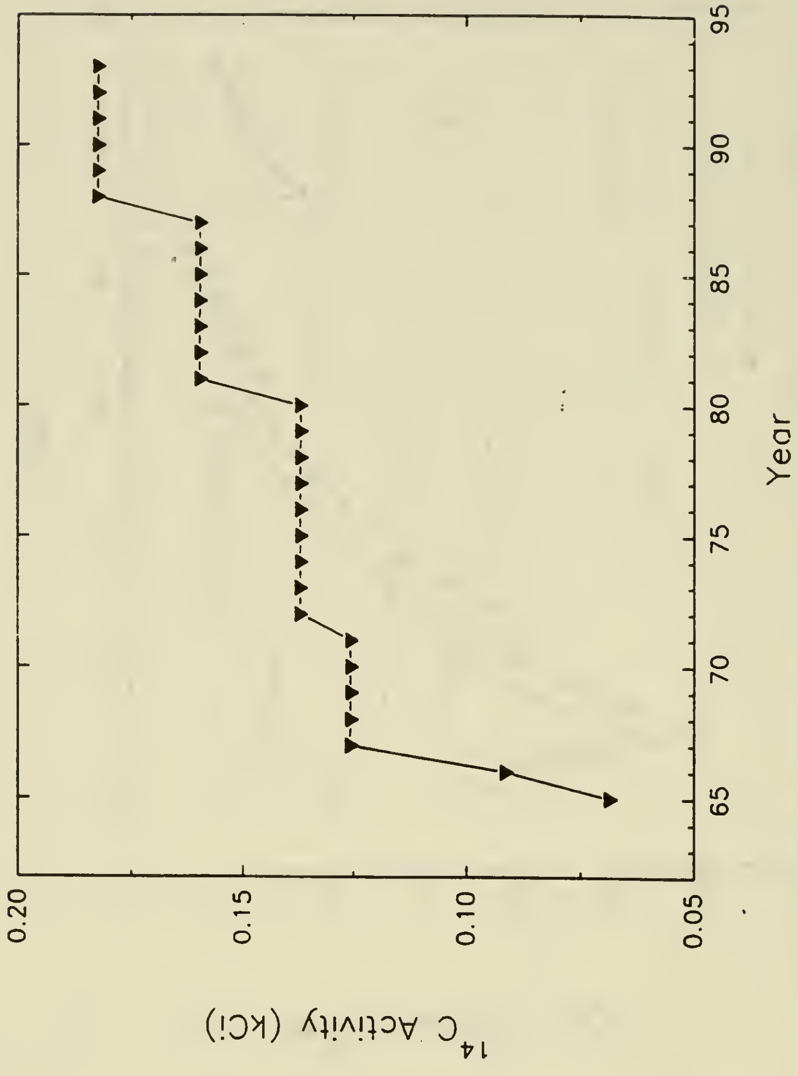


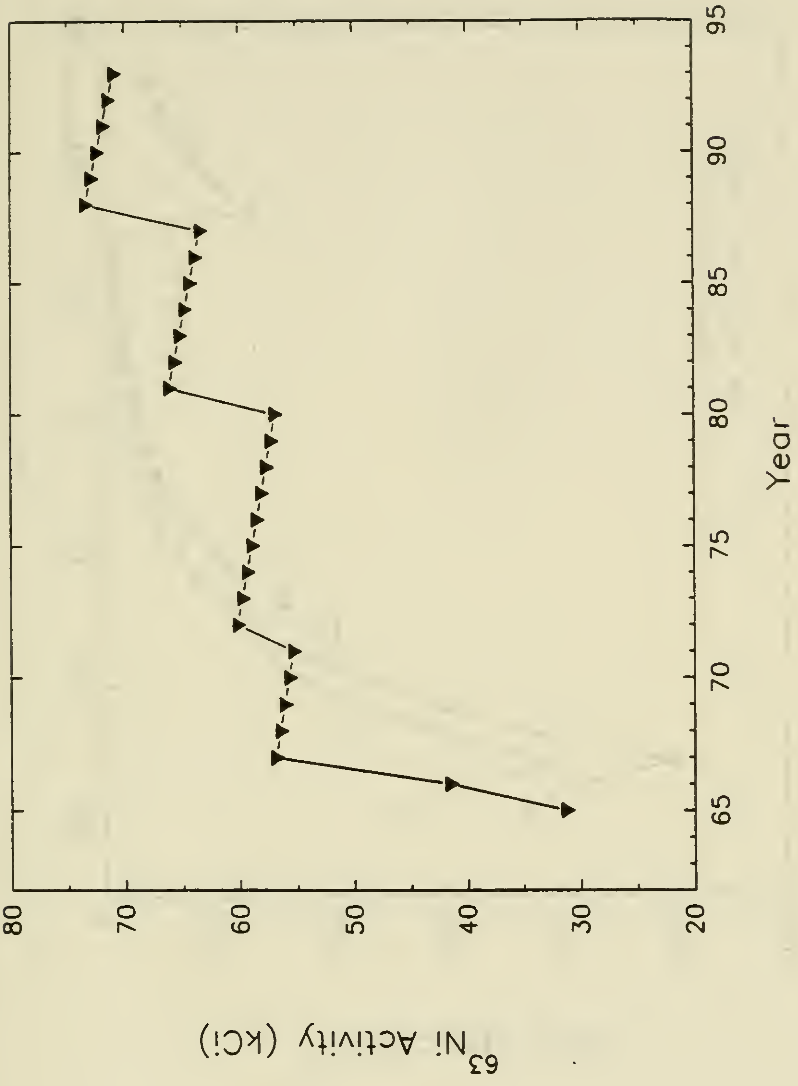
0.04
0.03
0.02
0.01
^{99}Tc Activity (kCi)
65
70
75
80
85
90
95
Year
● 36% S and 6.4% L – Minimum
○ 10% S and 4.6% L – Minimum

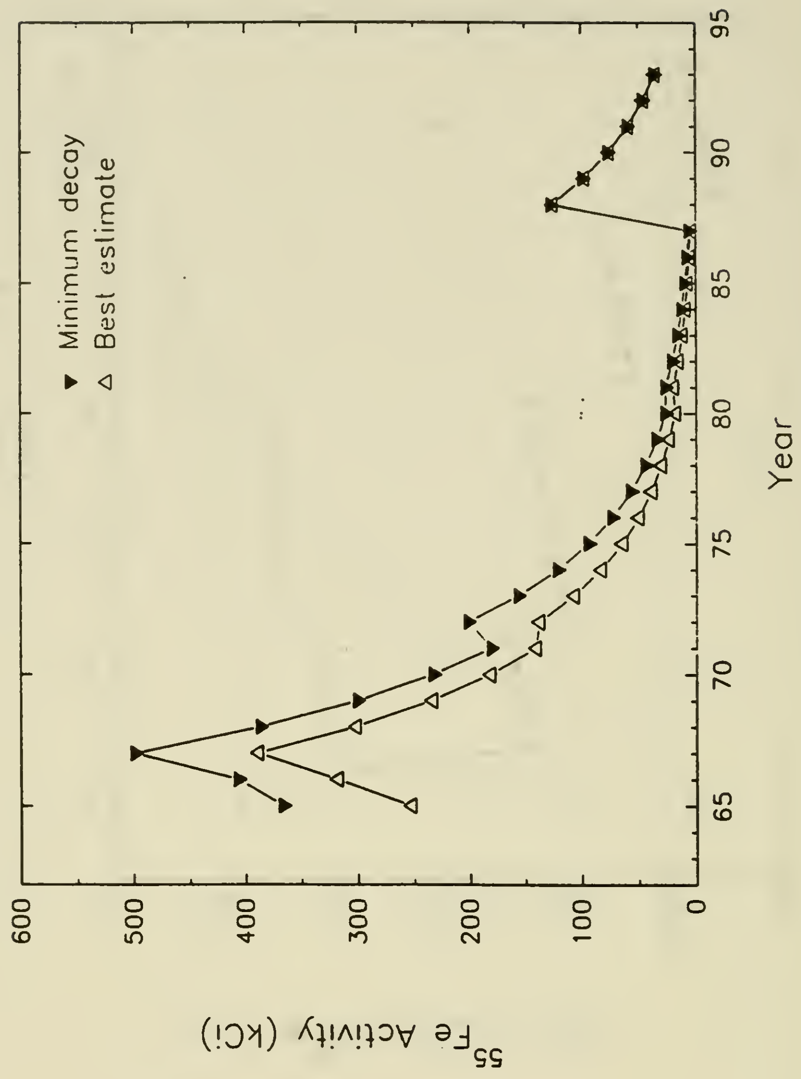


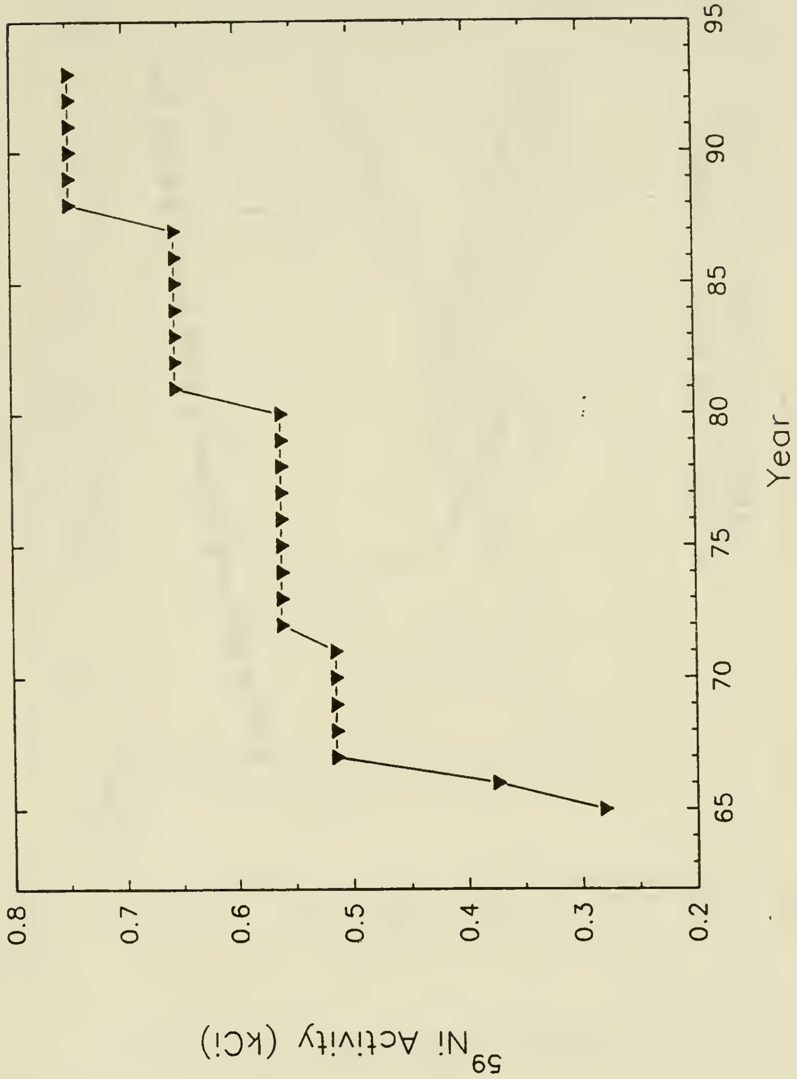
^{151}Sm Activity (kCi)
0.5
0.6
0.7
0.8
0.9
1
2
3
4
5
65
70
75
80
85
90
95
Year
● 36% S and 6.4% L – Minimum
□ 10% S and 4.6% L – Best

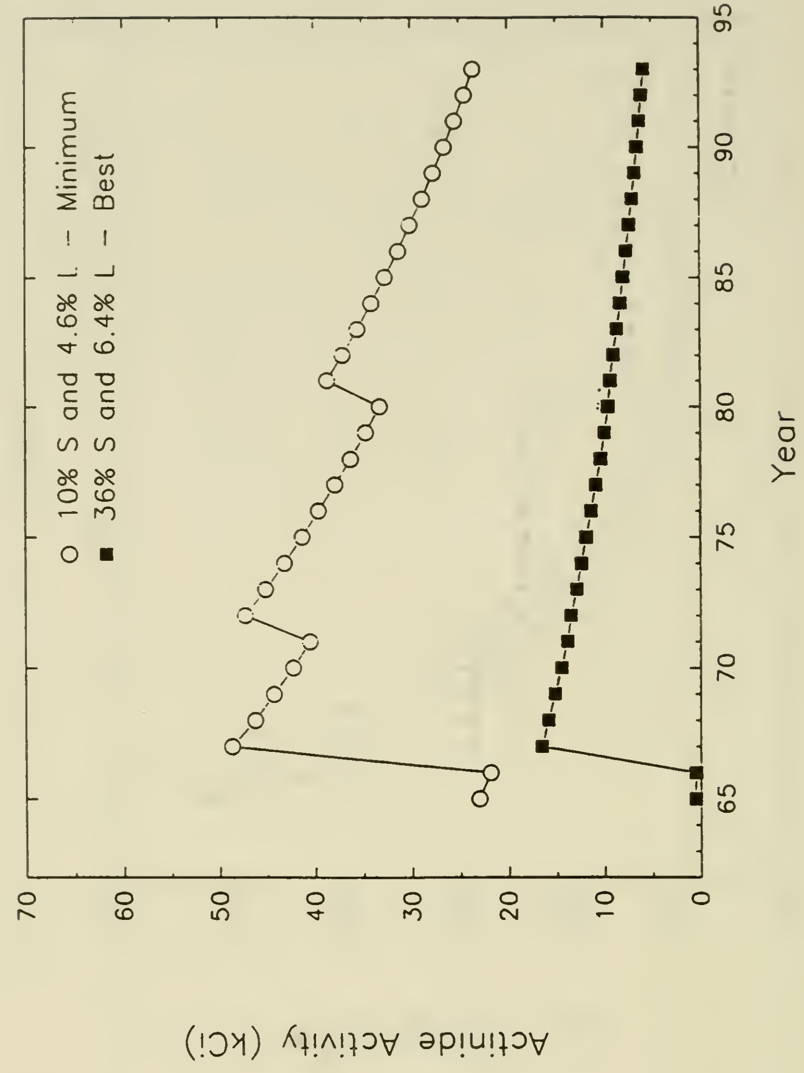

Minimum decay
Best estimate
Year
65
70
75
80
85
90
95
^{60}Co Activity (kCi)
0
20
40
60
80
100
120
140

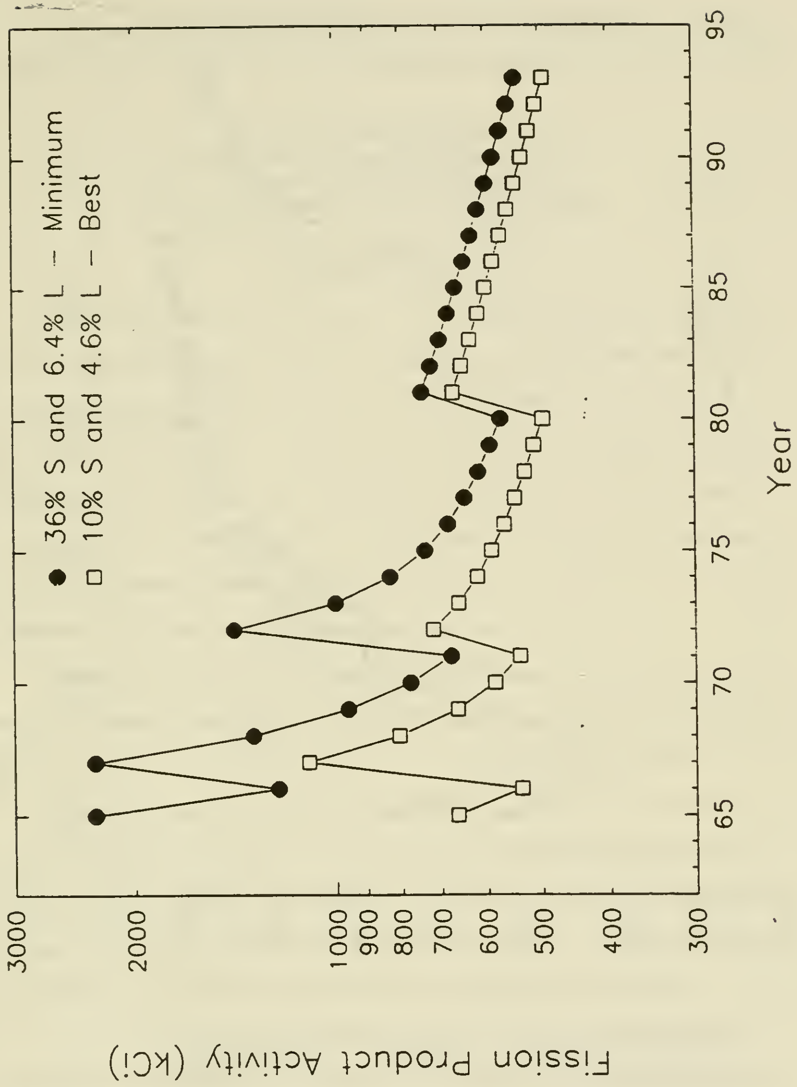

0.20
0.15
0.10
0.05
^{14}C Activity (kCi)
65
70
75
80
85
90
95
Year

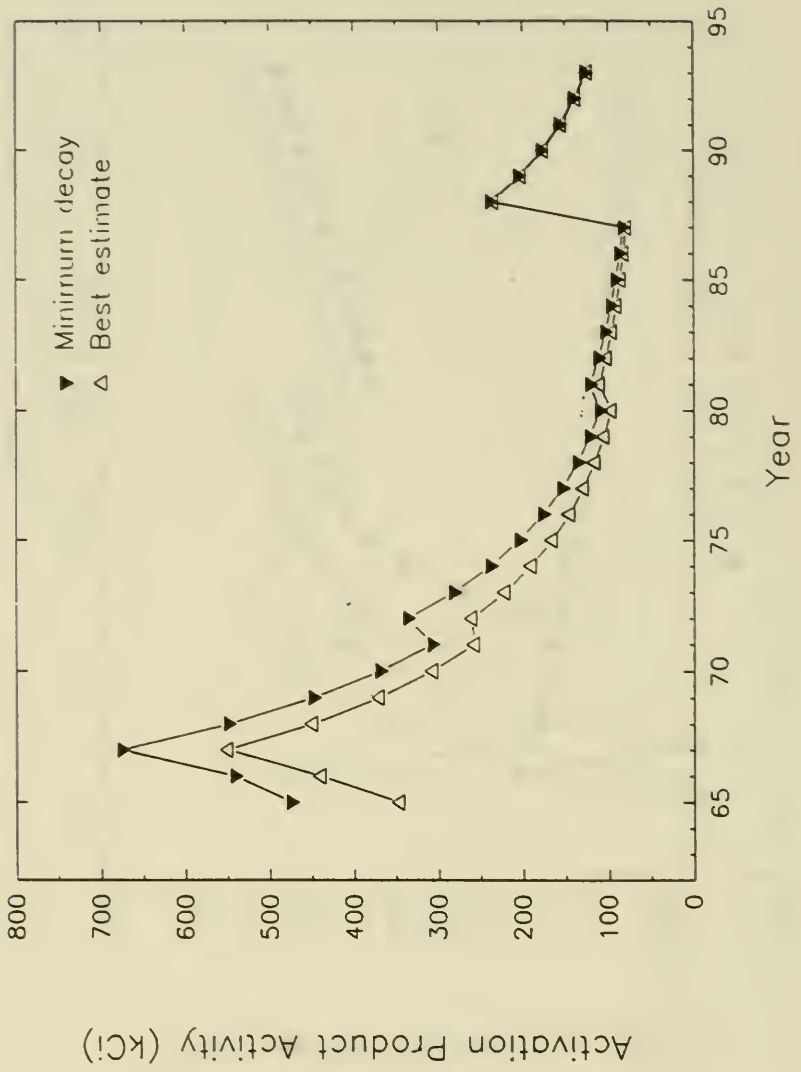

^{63}Ni Activity (kCi)
80
70
60
50
40
30
20
65
70
75
80
85
90
95
Year


▼ Minimum decay
△ Best estimate
^{55}Fe Activity (kCi)
Year
0
100
200
300
400
500
600
65
70
75
80
85
90
95


0.8
0.7
0.6
0.5
0.4
0.3
0.2
^{59}Ni Activity (kCi)
65
70
75
80
85
90
95
Year


○ 10% S and 4.6% L -- Minimum
■ 36% S and 6.4% L -- Best
Actinide Activity (kCi)
0
10
20
30
40
50
60
70
Year
65
70
75
80
85
90
95


● 36% S and 6.4% L – Minimum
□ 10% S and 4.6% L – Best
Fission Product Activity (kCi)
3000
2000
1000
900
800
700
600
500
400
300
Year
65
70
75
80
85
90
95


Minimum decay
Best estimate
Activation Product Activity (kCi)
0
100
200
300
400
500
600
700
800
Year
65
70
75
80
85
90
95

HOUSE SUBCOMMITTEE ON OCEANOGRAPHY

HEARINGS ON RADIOACTIVE CONTAMINATION IN THE ARCTIC OCEAN

U.S. House of Representatives
Committee on Merchant Marine and Fisheries
Subcommittee on Oceanography
Room 1334, Longworth House Office Building

Testimony of Charles D. Hollister
September 30, 1993

My name is Charles Davis Hollister. I received my Ph.D. in Oceanography from Columbia University in 1967 and have devoted my entire professional career to understanding how sediment is deposited and transported on the ocean floor.

Because much of the extremely hazardous radioactivity contained in nuclear waste, reactors and weapons affix to sea-floor sediment, the knowledge of how, when, where or if sediment is deposited or transported in the vicinity of such point-sources of radioactivity becomes a very critical issue in assessing the fate and effects of radioactivity placed accidentally or purposefully on the sea floor.

My work on sea floor sediments has resulted in about 100 publications and 4 books on this and related subjects since my first peer-reviewed paper was published 30 years ago.

I have also spent about 15 years assessing the implications of new scientific discoveries about sedimentary processes on the issue of the engineered disposal of high level nuclear materials into certain geologic formations below the sea floor. In this regard I have been asked to serve on many boards, panels, commissions etc. that have dealt with this problem (see partial list of my background, attached).

In the late 70's and early 80's the Navy began studies to look at alternatives for disposal of defueled nuclear submarines. I served as a principle scientist in the study of the environmental impact of one option, the disposing of defueled and decommissioned U.S. nuclear submarines onto the deep sea floor. The conclusions reached after about a decade of study by experts from across the U.S. was that certain extensive areas of the sea bed within the U.S. 200 mile Exclusive Economic Zone were suitable, from a scientific and technical standpoint, for such disposal and that no measurable harm to the environment would result. The study also concluded that such disposal was cheaper, and had less impact on ship-yard workers than cutting the reactor compartments out of the submarines and burying them on land. With both land and sea disposal options viable with minimal environmental impact, the Navy decided to proceed with land disposal.

I also served for twelve years as a principal scientist in a multinational effort to determine the scientific and technical feasibility of isolating high-level radioactive waste into certain extensive submarine geological formations; this was called the Sea-Bed Program by the Department of Energy, our sponsor. As a result of 11 years of study by scientists, engineers and policy analysts from 8 countries the Nuclear Energy Agency in Paris reported that ". . . subseabed burial appears to be a technically feasible method of disposal of high-level radioactive wastes or spent fuel."

DOE suddenly terminated this project in 1986. The Undersecretary for Waste Management stated that "nothing will erode public confidence in our ongoing land based operation [Yucca Mountain] faster than if we spend any money on a viable alternative."

I am very familiar with the political and scientific issues of nuclear material both on and beneath the deep sea-bed.

A member of the Supreme Soviet Parliament Valerij Menshikov personally revealed to me, last year, that the Soviets had been illegally dumping and burying nuclear waste and reactors onto the Arctic sea-bed for nearly 30 years. I was then asked by the Russians to become involved in this issue, and this I did do. My second trip to Russia was featured on ABC Nightly News and The New York Times.

In June I served as an organizer for an international conference [at Woods Hole] of over 100 scientists from 11 countries titled "Radioactivity and Environmental Security In The Oceans." The purpose of this major conference was "to re-evaluate, with a free and open exchange of scientific information, the current and future potential impact of artificial radioactivity in the marine environment."

The meeting emphasis was on the potential contamination of Russian Arctic dumping and the Russian nuclear powered and nuclear armed, attack submarine *Komsomolets* that accidentally sank in the Norwegian Sea. The meeting was sponsored by Department of State, Department of Defense, private foundations, foreign participants and the Woods Hole Oceanographic Institution.

The consensus of this workshop was that "There is NO evidence of any regional scale radioactive contamination in the Arctic and North Atlantic Ocean that currently poses a threat to human health or causes environmental concern." This and other conclusions were reported to the public by the New York Times 6/13/93 (see attached).

Because of my long standing interests and expertise on this subject I was invited by the Russian authorities responsible for the design of the ill fated *Komsomolets* to participate in a month-long monitoring expedition to the site of its sinking. A Cruise Summary written aboard the *Keldysh* by the scientists from the United States, Netherlands and Norway is attached. The results of this expedition was also reported by the New York Times on September 5 (see attached). In general, the present environmental impact of *Komsomolets* is judged by experts in the field of dose commitment to man to be insignificant until or unless laboratory results, precise sampling, and a clear image of the total damage to the submarine proves otherwise. In short, we found no evidence of a clear or present danger to the environment from the *Komsomolets*.

Moving to a more personal venue and focusing on the future I am concerned that certain vocal environmental advocates [especially Greenpeace] will continue to misrepresent and take out of context the findings of the legitimate and tax-payer supported scientific community in order to follow their own agenda.

Specifically I worry greatly for the future of those of us who are confined to live on planet earth that environmental advocates like Greenpeace will close off the ocean option and through political maneuvering and scare tactics may succeed in getting this Administration to favor a ban on EVEN the study of any marine radioactive disposal scenarios at the upcoming London Dumping Convention. Such a ban would foreclose any ocean floor or sub-seabed disposal of radioactive material, i.e. all waste would have to be deposited on land somewhere [someone's "backyard"].

As a person who lives on land and drinks water from this land I am personally offended, and scared, that Greenpeace is determined to make 70 percent of our planet "off-limits" for waste disposal of any kind, forever. I do, however, agree with some of their principles, i.e. that we should minimize waste production and recycle to the extent we can. But when wastes still exist, that are not recyclable, I suggest we look at ALL the alternatives. The ocean floor and the geologic formations below have to be examined as viable alternatives to the very small amount of land we are confined to live on.

The new knowledge of the scientific community about the deep sea and our substantial abilities in ocean engineering, recovery and monitoring technology makes this a particularly in-opportune time to favor such a ban.

I hope this Committee and its Chairman follow closely the debate that is now leading up to the next London Dumping Convention meeting and that the results of these hearings are presented to our Administration in a timely fashion so that a balanced decision may be made.

Respectfully submitted,

Charles D. Hollister

Charles D. Hollister
Senior Scientist, Department of Geology & Geophysics
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Attachments:
- Curriculum vitae of Charles D. Hollister
- New York Times articles dates 6/13/93 and 9/5/93
- Cruise summary of scientists from the United States, Netherlands and Norway

SUMMARY OF WASTE DISPOSAL ACTIVITIES
Charles Davis Hollister

Oceanographer/Sedimentologist
Senior Scientist, Vice President
Woods Hole Oceanographic Institution
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B.S. Oregon State University, 1960
Ph.D. Columbia University, 1967

Research Interests: Role of oceans in the management of hazardous wastes; sediment dynamics in the deep sea; oceanographic factors that control sediment distribution; geologic effects of near-bottom currents; paleoenvironmental modelling; high energy benthic boundary layer dynamics.

MEMBERSHIPS, PROFESSIONAL AND SCIENTIFIC AFFILIATIONS:

Chairman of workshop "Resource Potential and Environmental Stability of Planet Earth for the Next Million Years," U.S. Nuclear Regulatory Commission (NRC), Keystone, CO
Member, Review Panel on Waste Isolation Risk Assessment, Probabilistic Analysis Branch, U.S. Nuclear Regulatory Commission
Chairman, Consultants Meeting on Oceanographic Modelling for London Dumping Convention, International Atomic Energy Agency, IAEA.
Founder, International Seabed Working Group (Japan, US, U.K., France, Canada) Member, Institutional Task Force, DOE and Nuclear Energy Agency of O.E.C.D., Paris
Member and Chief Scientist, Technical Advisory Committee, Sandia Subseabed Radioactive Waste Disposal Program (DOE)
U.S. Delegate to Expert Panel on sea disposal of radioactive waste, International Atomic Energy Agency/Intergovernmental Maritime Organization
Technical Director, Keystone Radioactive Waste Management Discussion Group, Ford Foundation
Member, Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions of UNESCO, Working Group #61
Chairman, Marine Science Working Group, International Council of Scientific Unions, Paris
Member, National Academy of Sciences, National Research Council, Assembly of Engineering, Steering Committee on Engineering Aspects of Using the Assimilative Capacity of the Oceans

SELECTED PUBLICATIONS ON WASTE ISSUES

Seabed Disposal--Where to Look, 1974. Nuclear Technology, 24:425-443. Bishop, W.P. and Hollister, C.D.

Release Pathways for Deep Seabed Disposal of Radioactive Wastes, 1975. International Symposium on Radiological Releases from Nuclear Facilities into Aquatic Environments, Otanieni, Finland (SAND74-5854). Anderson, D.R., Bishop, W.P., Bowen, V.T., Brannen, J., Detry, R., Ewart, T., Hayes, D., Heath, G.R., Hessler, R., Hollister, C.D., Kreil, K., McGowen, J., Rohde, R., Schimmel, W., Silva, A.J., Smyrl, W., Taft, B. and Talbert, D.

Nuclear Wastes Beneath the Deep Sea Floor, 1975. Third International Ocean Development Conference, Tokyo (SAND74-5855). Bishop, W.P. and Hollister, C.D.

The Seabed Option, 1977. Oceanus, 20:18-25. Hollister, C.D.

Oceanographic Processes and the Ultimate Disposal of High Level Radioactive Waste, 1977. Amer. Nuclear Society, Annual Meeting. Hollister, C.D. and Rhines, P.B.

Site Selection for Geologic Disposal of High Level Radiation, 1978. Amer. Assoc. for the Advancement of Science, Annual Meeting. Washington, D.C., Hollister, C.D. and Deese, D.A.

Radioactive Waste Disposal in the Oceans, 1978. The Ocean Yearbook, pp. 340-348. Frosch, R.A., Hollister, C.D. and Deese, D.A.

Siting Considerations and Political Implications for the Disposal of High Level Nuclear Wastes Beneath the Deep Sea Floor, 1979. Proceedings of Marine Sciences and Ocean Policy Symposium: A Definition of the Issues and a Search for a Consensus on Multiple Uses, University of California, Santa Barbara, June 17-20, 1979. Hollister, C.D., Bishop, W.P., and Deese, D.A.

Identification of Generic Study Areas for the Disposal of Low Level Radioactive Waste: Western North Atlantic Ocean, WHOI Technical Report 79-82, 1979, 48 pp. Hollister, C.D., Bunce, E.T. and Chandler, R.S.

Characterization of Pelagic Sedimentation in the North Pacific: U.S. Subseabed Disposal Program, 1980. Marine Technology, Heath, G.R., Hayes, D.E., Silva, A.J., Hollister, C.D. and Leinen, M.S.

Submarine Geologic Disposal of Nuclear Wastes, 1980. IN: Underground Disposal of Radioactive Wastes, Vol. I, IAEA, Austria, July 2-6, 1979. Hollister, C.D., Corliss, B.H., and Anderson, D.R.

Pre- and Post-Dumping Investigations for Inauguration of New Low Level Radioactive Waste Dump Sites, 1980. Radioactive Waste Management, pp. 235-269. Bowen, V.T. and Hollister, C.D.

Nuclear Waste Management, The Ocean Alternative: Chapter 5: Sub-seabed Disposal of High-Level Nuclear Wastes. C. Hollister and T. C. Jackson (Eds.), The Oceanic Society, Pergamon Policy Studies, Pergamon Press, 1981. pp. 55-69.

Subseabed Disposal of Nuclear Wastes, 1981. Science, 213:1321-1335. Hollister, C.D., Anderson, D.R. and Heath, G.R.

Disposal of High-Level Radioactive Wastes by Burial in the Sea Floor, 1982. Environmental Science and Technology, 16(1):28A-37A, January. Hinga, K.R., Heath, G.R., Anderson, D.R. and Hollister, C.D.

Selecting Sites for Radioactive Waste Repository, 1984. IN: M. Harthill, Ed., A.A.A.S. Selected Symposium 88, Hazardous Wastes Management: In Whose Backyard?, pp. 63-97. Hollister, C.D. and Smedes, H.W.

Options for Waste: Space, Land or Sea? Editorial, Summer 1990. Oceanus, 33:#2, 13-18. Hollister, C.D.

Potential Use of the Deep Seafloor for Waste Disposal, 1992. IN: K. Hsu and J. Thiede (Eds.) Use and Misuse of the Seafloor, John Wiley & Sons, Ltd., Hollister, C.D.

CONGRESSIONAL TESTIMONIES

July, 1976 House Subcommittee on Energy and the Environment; Radiological Contamination of the Oceans.

November 1980 House Subcommittee on Oceanography; Environmental implications of proposed subseabed disposal of high-level nuclear waste.

July, 1981 House Subcommittee on Energy and Environment; Desirability of maintaining subseabed option for radioactive waste disposal.

October, 1982 House Committee on Merchant Marine and Fisheries; Disposal of Decommissioned Nuclear Submarines.

July, 1987 House Subcommittee on Energy and Environment; Use of subseabed disposal as an alternative method for disposal of radioactive waste.

August, 1992 Senate Select Committee on Intelligence; Radioactive and other environmental threats to the Arctic resulting from past Soviet activities.

NYT'S
Sunday
6/13/93

A-WASTE DANGERS DESCRIBED AS LOW

Scientists' Group Says Ocean Dumping Seems to Pose Only Local Threats

By WILLIAM J. BROAD

Special to The New York Times

An international group of 116 scientists and radiation experts has concluded that nuclear wastes dumped in the world's oceans over the decades apparently pose no global danger.

"Any potential problem would be a local one and would pose no threat on a global scale," the scientists said in a written statement issued on Thursday at a conference in Woods Hole, Mass. Some of the scientists have since criticized the statement as too sweeping.

The experts at the meeting at the Woods Hole Oceanographic Institution were reacting to a Russian report this year that said that the Soviet Union had dumped large amounts of highly radioactive waste into the oceans beginning in the late 1950's. The chairman of the report was Dr. Aleksei V. Yablokov, the top environmental adviser to President Boris N. Yeltsin of Russia.

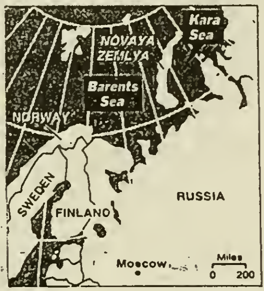
Moscow secretly dumped up to 2.5 million curies of radioactive wastes, or twice the combined total of 12 other nuclear nations. The wastes included 18 nuclear reactors from submarines and an icebreaker, many of which were ditched in shallow waters.

Ban on Dumping at Sea

The dumping at sea of such highly radioactive materials has been banned worldwide for more than 30 years, and the ban was extended a decade ago to low-level radioactive wastes, as well. In theory, the oceans can eventually dilute nearly any radioactive waste to the point of harmlessness. But local releases of high concentrations can be dangerous if picked up by marine life and carried into the food chain.

In its statement the group of scientists said that any local threats from the newly disclosed Russian wastes, which are mainly in the Kara and Barents Seas inside the Arctic Circle north of mainland Russia, were entirely theoretical and that no signs of dangerously high radiation levels had been detected in water samples.

"There is a strong consensus among conference participants that there is no evidence of any regional-scale radioactive contamination in the Arctic and North Atlantic Oceans that currently poses a threat to human health or causes environmental concern," the statement said.



The New York Times

Soviet wastes were dumped in the Barents and Kara seas.

The Woods Hole meeting was attended by 24 Russian scientists, including some who had worked on the Yablokov report, as well as scientists from Austria, Canada, Denmark, France, Germany, Monaco, Norway, Britain and the United States. Most are experts in radiation, ecology or oceanography.

Monitoring of Dump Sites

The group called for better monitoring of known waste sites, because there is almost no data based on direct observations on whether sunken reactors and steel drums that hold radioactive wastes are intact. Five cruises are planned for this summer by Norway, Russia and the United States to monitor the general health of the Barents, Kara and Norwegian Seas and, possibly, the radioactive dump sites. Last year a ship carrying a Norwegian and Russian team was barred from access to the sites.

At a news conference at Woods Hole the deputy director of the Russian environmental ministry, Dr. Vitali N. Lystsov, said he had calculated that the 2.5 million curies that the Soviets dumped had decayed over the years to 0.3 million curies.

Western estimates for the current radiation range up to 0.7 million curies, Dr. Lystsov said, adding that the figures were all uncertain because of inadequate information on exactly what was dumped. The group called for the declassification by East and West of "all existing data regarding nuclear materials in the ocean." The issue is militarily sensitive.

Loss of Soviet Sub

At the news conference an ecologist and member of the Supreme Soviet, Dr. Valerij Menshikov, said Moscow had provided considerable data about the Soviet submarine Komsomolets, which sank 300 miles off the Norwegian coast in 1989 with a nuclear reactor and two nuclear torpedoes on board. They lie in waters a mile deep.

In its statement the group dismissed the risk of danger from such objects, saying nuclear submarines and weapons lost at depths of a mile or more "do not pose any significant present or future threat to human health or the environment in which they lie."

"I hope," Dr. Menshikov said, "the United States will be as open" about the Scorpion, a nuclear submarine that sank 400 miles off the Azores in 1968 in waters more than a mile deep. Two nuclear torpedoes were reportedly on board, although the Navy refuses to discuss the issue.

New York Times

9.5.93

HAZARD IS DOUBTED FROM SUNKEN SUB

Plutonium Escaping Soviet Vessel Would Stay on Sea Floor, Scientists Say

By **WILLIAM J. BROAD**

Western scientists who examined a sunken Russian submarine have found that it was torn by a violent explosion and has possibly leaked plutonium from its nuclear torpedoes. But they concluded that any radioactivity would lie on the sea floor near the submarine rather than be swept toward rich North Atlantic fisheries, because the currents around the hulk were far weaker than previously believed.

"If you're looking for a place to put it, this isn't as bad as we thought," Charles D. Hollister, senior scientist at the Woods Hole Oceanographic Institution on Cape Cod, said in a telephone interview last week on returning from the voyage.

The scientists just completed a monthlong expedition to examine the vessel, the Komsomolets, which sank in 1989 in waters a mile deep in the North Atlantic, 300 miles off the coast of Norway.

Debate Over Health Hazard

Experts have repeatedly clashed over whether the corroding hulk poses a risk to human health, with some Russians arguing that the danger is high.

Begun in late July, the expedition consisted of Russian, American, Norwegian and Dutch scientists sailing aboard a Russian research ship. The cruise was the first big East-West effort to examine the Komsomolets, the sinking of which took 42 lives.

The experimental sub was among Moscow's top secrets during the cold war. Its titanium hull was to let it dive very deep. Instead, crippled by fire, it sank, with a nuclear reactor and two nuclear-tipped torpedoes on board.

The recent examination of the wreck was done by a Russian research ship, the Akademik Keldysh, which lowered two small deep-diving submarines equipped with cameras, sensors, robots and sampling tubes.

A big surprise, Dr. Hollister said, was evidence of the large explosion in the sub's torpedo compartment, including a ragged hole 20 to 30 feet across. The hole was ringed by a welter of twisted metal colored in bright reds, yellows and purples.

"We were all surprised at how fast corrosion was taking place," Dr. Hollister said, adding that some of the nonnuclear torpedoes nearby were seen to be "oozing out" of their tubes.

Torpedoes 'Mashed Up'

The nuclear torpedoes could not be examined directly, he said, but external evidence suggested they were probably "mashed up" in their tubes and possibly leaking plutonium from their warheads.

Plutonium does not dissolve in seawater. As it flakes and corrodes, Dr. Hollister said, it would tend to bind with nearby sedimentary clay particles, which would lie on the bottom unless stirred up by undersea storms or strong currents.

"Everybody agrees you're not going to get the nukes back," Dr. Hollister said, referring to earlier speculation about the possibility of raising the warheads for disposal.

Russian researchers on the voyage took samples of nearby bottom sediments, which are to be studied on land for signs of plutonium contamination. But Dr. Hollister said the sampling methods were so crude and restrictive that he doubted they would provide "definitive answers concerning release rates of radioactivity."

As for the sub's nuclear reactor, the Russian scientists found signs of leaking cesium-137, a dangerous radioactive byproduct of fission reactions, near one of the submarine's vents. But the levels were quite low, Dr. Hollister said, and similar non-dangerous levels had been detected on earlier inspections of the wreck by the Russians.

Currents Found to Be Weak

Most important, Dr. Hollister said, is new evidence that bottom currents in the area are quite weak, virtually eliminating the danger that leaking plutonium might be swept into the rich fishing grounds of the North Atlantic. Instruments found the underwater currents to be quite slow, moving at a rate of about one mile an hour.

Moreover, Dr. Hollister said, scientists on the voyage from Woods Hole and the P. P. Shirshov Institute of Oceanography in Moscow found "major errors" in earlier measurements and reports of fast currents by the submarine's designers, the Rubin bureau in St. Petersburg.

On an earlier voyage, he said, "Rubin had measured some currents and used the wrong conversion factor."

Igor D. Spassky, director of the Rubin bureau, argued in an Op-Ed page article in The New York Times in June that a strong flow in the area made the Komsomolets dangerous. "Finely dispersed plutonium would be carried by currents for about 60 miles," he wrote, contaminating Atlantic fisheries.

But Dr. Hollister said visual inspections showed that the ocean floor near the submarine was placid. "Nothing has been through there in the last 10,000 years that matches the kind of velocities they were talking about," he said

Dr. Hollister added that heavy sediment was raining down on the ocean floor in the area, accumulating at the rate of about an inch or so annually.

"It's raining down and staying put," he said. "In a sense it's a natural cleansing. Any radioactive particles that get out will be buried. When all is said and done, the situation is not all that bad."

Cruise Summary
Scientists from United Stated, Netherlands and Norway
Aboard Keldysh, Cruise #31 to Komsomolets site
Dated August 29, 1993

The primary objectives of this international expedition were:

1. to apply and to evaluate monitoring procedures for the determination of levels of radiation and radionuclide concentrations originating from the reactor and the nuclear weapons on board for the purpose of the assessment of the extent to which the vessel is a present and/or future source of release of radionuclides into the environment at a level that would be harmful to the biosphere.

2. to investigate the structural integrity of this vessel, its reactor and its nuclear weapons in order to evaluate scenarios for any possible future work like long term isolation, if justified, of its radioactive inventory from the environment.

3. to obtain biological, physical, geological and radiation measurements of the region on and around this vessel in order to assess what if any environmental hazard has resulted from this accident.

ITEMS OF AGREEMENT

1. We agree that it is useful to combine many talents from many Institutions to develop marine deep water radiation and environmental monitoring systems as is justified relative to cost and predicted hazard.

2. We agree that while these systems are being developed that the best available effort will be made to do the radio-ecological monitoring of the water, suspended matter, sediments and biota as close as possible to the source, and with precision in regard to natural variability and regard to where the samples are in relation to the sediment-transporting currents.

3. We agree that the intercalibration of methods of measurement of radioactivity is of prime importance to the understanding of rates and routes of release of any radionuclides into the biosphere.

4. We agree that a global inventory of radioactive objects on the sea floor be established and for now it is assumed that the International Atomic Energy Agency is the relevant authority and that we share our findings with that agency.

5. We agree that development of scientist-to-scientist contacts be encouraged and papers exchanged. The *Keldysh* cruise #31 was particularly successful in this regard; friendships have been made, papers have been distributed, and plans to jointly publish results have been established.

6. We agree that we have made progress in the determination of what a sea-floor monitoring system for point sources of radioactivity should be composed of, see below.

7. We agree that before publication of scientific data obtained from the cruise K-31 draft copies of reports be distributed to appropriate colleagues for comment, additions of data, and discussions of interpretations. This will be done on an individual basis.

8. We agree that while we don't intend and are not able to control the media, when interviewed we will keep close to the facts as we understand them.

9. We agree that the cruise was a success and that good data were obtained and shared as appropriate; total openness by all was apparent and appreciated .

RECOMMENDATIONS FOR THE FUTURE:

1. We think the cost is not justified tc do more regional surface sediment geology, geochemistry or benthic biology unless future laboratory analysis reveals unusual patterns that need, for radionuclide transport or isolation considerations, further sampling.

2. We recommend that because of the importance of advective forces in moving radionuclides that near bottom currents and turbidity be measured near the *Komsomolets* for time periods of the order of one year.

3. We recommend that Rubin or another appropriate organization contact Norwegian, Russian and/or American defense organizations to obtain an annual set of deep expendable bathythermograph records in order to determine maximum depth of "surface mixed layer". If that fails then we recommend that a one year intensive measuring program for depth of mixing be initiated as soon as possible. We recommend that ASW P-3 planes using maximum depth expendable bathythermographs [X BT's] be utilized for the first year and that bi-monthly determinations of penetration depth of the isothermal layer is justified on the basis of need-to-know vertical mixing.

4. We recommend that a modest monitoring program be initiated, if not already in progress, to examine fish caught commercially in the *Komsomolets* area for evidence of bottom feeders, e.g. mud in guts, and for any other evidence of extensive vertical migrations of commercial species.

OTHER CONSIDERATIONS:

In addition we considered other broad categories of issues that need to be considered in a monitoring program for *Komsomolets* [and other point sources of radioactivity] and concluded the following categories must be considered:

1. Source terms or release rates from *Komsomolets*, reactor and two nuclear torpedos and in this regard we recommend specifically:

That samples of sediment from as close as possible to the nuclear torpedos' warhead be obtained for laboratory analysis for the alpha emitter Plutonium 239, and that Cesium 137 be measured at or in the "reactor ventilator" by in-situ gamma ray spectrometers. To determine mixing rate and current vectors, a three component current velocity, turbulence, and Reynolds stress sensors [presently available as a small benthic acoustic stress sensor BASS] be deployed at the same place. We do not believe cost is justified to do these measurements more frequently than every 2-5 years and at present technology a manned submersible will probably be required to refurbish these sensors.

TESTIMONY QUESTIONS SUBMITTED BY
Charles D. Hollister
TO SUBCOMMITTEE ON OCEANOGRAPHY GULF OF MEXICO AND THE OUTER CONTINENTAL SHELF
September 30, 1993

Q: You quoted in your testimony from the workshop's statement of consensus that there is no evidence of regional scale contamination. Are you saying that the radioactivity poses no threat, or is it that we just have no evidence that there is a current threat?

A: The consensus that there is no regional scale contamination is correct. This in reference to the Russian dumping in the Arctic based on data we have obtained over the past 30 years. The only measurable signal of radioactive contamination in the entire Arctic is related only to the Chernobyl fallout, global atmospheric testing, and the effluent from the U.K. and French reprocessing plants. We have detected no radioactivity in the Arctic that could be traced to the Russian dumping activity. That is not to say that there will never ever be a threat but that there is none measurable now nor has there been in the last 30 years. The only threat that the workshop scientists (as opposed to Greenpeace legal counsel) could conceive of is the possibility of radioactive contamination within the immediate (centimeters to meters) vicinity of point sources of high level radioactivity. It has to be stated that to date we have not been able to sample that close to any point source in the Arctic yet but like other point sources we have studied from U.S. dumping practices we anticipate a small amount of radioactivity will eventually leak when the point source barriers corrode and that measurable amounts may be found against the sources. Calculations that we made at the conference suggested that even if all the radioactivity in these point sources was released instantaneously at some future time one could not calculate, using any reasonable assumptions, a dose back to man through the food chain of any significant radiological consequence. The amount of radioactivity is very small and is continually getting smaller as the isotopes decay into stable non-toxic forms and because of the scales of the ocean sediment and fauna that pertain to this part of the world.

Q: Could you define what the consensus statement meant by regional scale? Are you referring to the entire Arctic Ocean, or some part of it?

A: By regional scale we mean that the Kara Sea is not contaminated, the Barents Sea is not contaminated, the Novaya Zemlya trough is not contaminated nor, of course, is the entire Arctic contaminated.

Q: Most of the other witnesses today testified about the need for further information and instituting some sort of monitoring. What do you think are the appropriate actions?

A: On this I agree whole heartedly, complacency is not what I recommend. I think some form of monitoring has got to be established for these as well as other point sources of high level radioactivity from both the U.S. and Russian sources but the definition of monitoring has got to be thought of very carefully. The type of monitoring is probably going to be driven more by political pressures and public perceptions rather than by scientific necessity. I do, however, agree with the other witnesses, that some form of monitoring should take place and we have tried to do so during at least six cruises last summer. Unfortunately, we were denied access to the point sources and therefore there are many samples that I suspect will show nothing which is not to say that nothing is happening. The bottom line in this discussion is the sampling problem I referred to above. At present we are incapable of sampling the very fine grained "fluff" layer of material that is the most recent sediment deposited next to the point sources because our sampling techniques from surface ships as well as from submersibles blows away the sediment prior to sampling. There is a need to perfect a fluff layer type sampling system that would allow one to go into and underneath and around the point sources of radioactivity and precisely sample the sediment that is **most recently** deposited. This would be the sample most likely to contain the signal because most toxic radioactive material tends to stick to the clays and that would be where we would find the first signal. And yet we are not able to sample that.

Q: Mr. Colson mentioned in his testimony that the Russians are proposing to seal some of the torpedo tubes on the Komsomolets. In light of your testimony, this seems to be an unnecessary step. What do you believe is the reasoning behind this decision?

A: I feel that statement is meant to (1) calm the public and to indicate that the Russians are serious about the problem and (2) that they are now anxiously looking for financial support to do a variety of operations on the Komsomolets. As a result of spending a month at sea studying the Komsomolets I feel that the sediment that is naturally raining down onto and into this submarine as well as onto and into the nuclear torpedos tubes is sufficient to isolate whatever plutonium may leak out.

I base this on the knowledge of what plutonium does in the marine environment. It basically rusts, or oxidizes and minute flakes then fall off onto the sediment where it is bound up in the electrochemical way to the sediment itself. I feel because (a) the amount of plutonium is very small and (b) the release rate is very slow, on an ion-by-ion basis that it is not necessary **from a scientific point of** view to seal the torpedos. However, from a public perception point of view and from the Russians need for hard currency the sealing of the torpedos may be more of a political answer to a perceived problem than a scientific answer to what we believe to be a non-problem. We base this on the fact that our calculations show that if you dissolve the two nuclear torpedos instantaneously that once again given the sedimentation rate and the environmental data that no significant radiological impact to the food chain is possible. In fact our calculations show that if you dissolve the **entire** submarine, weapons and all that it still would not be a threat.

Q: Do you think that all of the information that exists pertaining to this problem has been released at this point?

A: I have no way of knowing the answer to this question. Like everybody else we can only surmise that what we have been told is right and I suspect that there may be more surprises ahead as the Russian military continues to release more information.

Q: With the new knowledge that we have, do you think that there is a need to reevaluate the purposes and mandates of the Arctic Research and Policy Act?

A: I think for any act designed by humans that it is always a good idea to reevaluate the purposes and mandates but my sense is that one should do it on the basis of fact and probably on a five year time frame. One might be able to obtain new information, do the analysis, do the subsequent interpretation, then one could view the policy in light of this new information. At the present moment I think the act as it stands is relevant to today but not necessarily for tomorrow. I recommend periodic reevaluation.

Q: The Yablokov Report outlines some blatant and relatively recent violations of international law by the former Soviet Union. How was the report received within the current Russian scientific and military communities?

A: The Russian scientific and military individuals that I have spoken with since the report was published have the same reaction that the Westerners do, i.e. it was a surprise and embarrassment. Given the lack of alternative places to put this material and the lack of technology and financial support to take care of their nuclear problems the way we do, the sense I get is that they had no choice and that they felt the harm to the environment would not be so severe as to make this a big issue. Nevertheless they did violate international law, as have other countries in the past, and as other countries will do in the future. But with the advent of the free press in the Communist world it may turn out, as in the West, that public perception and reaction will have a governing impact on such practices in the future.

Q: Can you describe what is known of the integrity of the waste containers and reactors which have been dumped? How high is the risk of significant leakage from these containers, especially considering the physical conditions which they are exposed to (including ice)? What is the likelihood of barrels and other wastes being transported by current and ice motions?

A: To my knowledge not a single barrel or reactor on the bottom of the Russian Arctic has been surveyed, photographed, or in any way closely examined. One can only surmise that if a reactor or a container of waste were put in a shallow area where ice could gouge or scrape them, then these items may be damaged in one way or another but regardless of what has happened or is happening, the bottom line is that nothing measurable has escaped yet. If they are being damaged, moved, transported, by currents and if the impact of that activity was going to somehow release the material into the environment, we should have measured some and seen the results of such activity. So far there is none.

Q: Could you please catalogue, from the information which has been provided to this point, the wastes which have been dumped (including amounts, locations, isotopes, and half lives)?

A: One can only refer to the Yablokov report, which has been much discussed in these hearings, and use that as your inventory. Clearly a principal responsibility of the International Atomic Energy Agency is making such a catalogue or inventory, and keeping it current. I would suggest that you ask this question of that organization.

STATEMENT OF
CLIFTON CURTIS, OCEANS ADVISOR
POLITICAL UNIT, GREENPEACE INTERNATIONAL

BEFORE THE
SUBCOMMITTEE ON OCEANOGRAPHY
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES

CONCERNING
RADIOACTIVE CONTAMINATION IN THE ARCTIC OCEAN

SEPTEMBER 30, 1993

Mr. Chairman, and Members of the Subcommittee. I am Clifton Curtis, Oceans Advisor with Greenpeace International's Political Unit.* Greenpeace is an international environmental and peace organization dedicated to protecting the planet through non-violent direct action, public education and legislative lobbying. We have offices in 30 countries, with 1.6 million supporters in the U.S. and 4.5 million worldwide.

I am pleased to participate in today's hearing to discuss radioactive contamination in the Arctic Ocean. Several considerations, among others, underlie our interest in this issue:

* protection and conservation of ocean and coastal areas, and the species that reside therein, has been a long-standing and important issue of concern to Greenpeace in this country, and elsewhere around the world;

* nuclear weapons and military and civil nuclear power plants are a major concern to my organization, and we seek the elimination of nuclear technology for several important reasons, including its environmental dangers to Arctic regions and the rest of the planet; and

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* Special assistance in the preparation of this testimony was provided by Joshua Handler, Simon Carroll and Remi Parmentier, all with Greenpeace Int., and by Pamela Miller, with Greenpeace in the U.S.

• with offices and membership in the 8 countries adjacent to the Arctic Ocean -- Canada, Denmark, Finland, Iceland, Norway, Russian Federation, Sweden and the U.S. (including Alaska), issues involving the Arctic are of special concern to my organization.

Scientific Unknowns

Considerable amounts of data have been presented about radiation in the Arctic since September 1991, when the first major public revelation of radioactive waste dumping by the former Soviet Union was made. However, the state of our knowledge has not been advanced significantly when it comes to determining future threats to the marine environment in the Arctic and the populations in the region. A large amount of radiation has been dumped and the possible effects on the environment are not yet known.

A series of increasingly credible reports from Russia, culminating with the release of the official Russian "White Book" on the dumping of radioactive waste at sea in March 1993, have detailed the extent of the dumping in terms of overall physical volume and estimated radioactive inventory at the time of dumping.

The most dangerous items known to have been dumped in Arctic waters include 16 damaged naval nuclear reactors and one reactor screen -- 13 reactors from submarines and 1 reactor and 1 screen from the Lenin nuclear-powered icebreaker -- dumped in the Kara Sea near the Novaya Zemlya islands. Six of the submarine reactors and the Lenin's reactor screen contained damaged spent nuclear fuel.

The Russian White book estimates the total radioactive inventory at the time of dumping of the damaged reactors/reactor screen at the time of dumping to be 2.3 million curies -- a considerable quantity of radiation. Unfortunately, detailed information about the radionuclide composition of the dumped matter, and the state of containment, is still absent. Such information is needed to understand what future dangers may arise.

Scientific attempts to gather such information have not been successful so far, although the results of the current Norwegian-Russian expedition will hopefully help change that situation. Unfortunately, the single international expedition to examine the problem for which results are available -- the August-September 1992 Norwegian-Russian expedition -- was very limited in its ability to do a survey. It was only permitted to gather samples at 11 small points in the Kara Sea, none of which were above or near the areas where reactors had been dumped.

Existing scientific information about radiation in the region have merely confirmed that up to now no major leakage of radiation has occurred, since none has been detected in the water or sediments at some distance from the sites where the reactors with fuel were dumped. In this regard, the authors' draft final results of the Norwegian-Russian expedition as presented at a August 1993 conference in Kirkenes, Norway, concluded: "The possible radiological impact on man and the environment as a result of the observed levels of contamination is extremely low" (p. 61) [emphasis added].

Due to the limitations on the expedition, however, the authors recommended: "Further investigations of radioactive contamination should be carried out in the Arctic Seas, paying special attention to the actual dumping sites of radioactive wastes in bays at the eastern coast of Novaya Zemlya and the Novaya Zemlya trench" (p.63) [emphasis added]. Also, in regards to possible effects, the authors concluded: "The results of the investigation show that, at present, the influence of the dumped radioactive wastes on the general level of radioactive contamination in the Kara Sea is insignificant. However, local effects in the vicinity of the dumping sites cannot be excluded, as these areas were not investigated." (p. 62) [emphasis added]

Captain Tengiz Borisov, Chairman of the Russian Government Committee for Special Underwater Operations, who has responsibility for monitoring and possibly remediating the dumped materials, recently offered a similar overall assessment of the situation in the Kara Sea. On September 16, 1993, he stated in ITAR-TASS that despite traces of radioactivity in the Kara Sea, the situation is "quite normal." But ITAR-TASS reported that he added:

> Nevertheless, the corrosion process which is destroying containers with radioactive waste, dumped near Novaya Zemlya, is developing, and the danger of their depressurisation is quite real. Now the leakage of radioactive substances into the water is a little higher than the natural background, but it may grow in the future. In several years we may face the problem of serious contamination. [emphasis added]

He also said that specialists from the committee are now working on ways to ensure the safety of the dumped materials including the possibility of salvaging them.

Thus, the scientific and technical unknowns are still quite large. In addition, there is other evidence which suggests a cause for concern. The Russian White Book says, in pertinent part (pp. 56-57):

> It must be kept in mind, however, the possibility of accidental contact with individual quite dangerous items in the future, as result, for example, of removal during diving work, storm throw-out onto the shore from shallow bays of the islands of the Novaya Zemlya archipelago, which hold a significant portion of the dumped RAW [radioactive waste].

* * *

> In order to avoid accidental human contact with radiation contaminated objects thrown out onto the shore, the Northern test site Novaya Zemlya conducts annual visual examination of the coastal zone of the eastern coast of the islands of the Novaya Zemlya archipelago.... No items or artifacts of radiational danger were discovered, with the exception of 1984, when on the coast of the Abrosimova Bay on the Novaya Zemlya archipelago an identified metal structure was discovered emitting high level of radiation (more then 100 R/hour) -- fragments of fuel element. [emphasis added]

In addition to storms, there is also the prospect that long keels of ice protruding downwards into the water from the ice sheet above could catch, move, and/or breakup dumped materials. This is a well known phenomena in the Arctic seas, which leads to the reworking of parts of the sea floor in shallower areas as these ice-keels scour the bottom.

Nonetheless, some scientists have already preliminarily concluded, despite the paucity of effects-related data, that there is at present no threat of global environmental consequences posed by the materials dumped in the Arctic. However warranted or unwarranted such a conclusions may be, it should not obscure the fact that 1) contained, long-lived radionuclides, are likely to pose greater environment threats once the containment barriers are breached by corrosion or ice scouring, and 2) effects "limited" to the Arctic are not inconsequential or trivial.

The situation with the Komsomolets submarine is roughly parallel. In the September 16, 1993 ITAR-TASS report, Captain Tengiz Borisov, who is also involved with monitoring the situation with the sunken Komsomolets submarine, gave his perspective on the situation. As ITAR-TASS reported:

> "he stressed that the Norwegian Sea was clean so far. There are only individual traces of radiation, slightly exceeding the natural background. Nevertheless, the emission of plutonium from the warheads may produce a long-term pollution of Norway's and Russia's area of economic interest, known for intensive fishing. [emphasis added] However, the raising of all the

> submarine is out of the question, Borisov stressed. The damages are so great that the submarine may fall to pieces if attempts are made to raise it to the surface, he added."

Nonetheless, plans to seal the forward part of the submarine where the nuclear torpedoes are located are described as a temporary measure until the forward section or warheads can be raised so they can be rendered harmless.

Clearly, much more needs to be ascertained about the situation with the Komsomolets submarine as well. Heretofore efforts by individual scientists or scientific institutions going to Russia on an ad hoc basis have not clarified the situation. (See, e.g., New Scientist article, p. 7, September 18, 1993) Government-to-government negotiations and/or a program of special assistance may be needed to fully understand the situation and reliably report it to the American public.

U.S.-Russian Expeditions to the Kara Sea and Related Information

Ten million dollars of the Nunn-Lugar funds were earmarked for studying the threat posed by radioactive contamination of the Arctic in FY 1993. Although these funds supported other worthwhile work to investigate radioactive contamination of large river systems flowing into the Arctic, the concern of the dumped materials in the Kara Sea went unaddressed.

A planned joint U.S.-Russian expedition to the Kara Sea fell through at the last minute. Already severely limited in its access, further restrictions were put on the expedition's planned itinerary by the Russian Navy in late July 1993. The U.S. side responded with diplomatic demarches and finally an ultimatum, but the Russian Navy refused to allow the desired access so the U.S. side canceled its participation in the expedition..

Greenpeace staff spoke with Admiral V. Selivanov, Chief of the Russian Navy's Main Naval Staff. in early September, concerning their Navy's opposition to the planned expedition. It was his view that, judging by the route, scientific plan, and description of equipment the Americans provided for his consideration, that the primary purpose of the expedition was spying, not science. He also said that the main piece of equipment that concerned him was a sonar which would allow charting of the ocean floor with a one-meter resolution. Such information, in his view, would allow U.S. submarines to determine their precise location any point in in the surveyed area without surfacing. Nonetheless, he stated that if a request were made for an expedition in 1994, it would be seriously considered.

Despite the expedition's 1993 cancellation, the U.S. should begin planning for an expedition next year, incorporating discussions with the Russian Navy about the nature and intent of the expedition; making use of Russian Navy scientific ships; and involving civilian and military scientists on the Russian and American side. Moreover, the expeditions' concept and planning would be strengthened by focusing on a broader spectrum of scientific and technical expertise. Rather than overemphasizing physical oceanography agenda, as was the case with the canceled expedition, more natural scientists -- e.g. marine and terrestrial biologists -- need to be involved. Also, the medical community which has the expertise to help evaluate threats to human health need to be represented in these kinds of expeditions.

Finally, more people from the technical community -- engineers and salvage experts -- need to be involved. As discussed more fully below in the context of remediation, retrieval of dumped reactors and other radioactive material merits serious consideration. Yet it was a noticeable shortcoming of this year's expedition, as no one from the navy or civil salvage community was incorporated into the expedition. Indeed, there seemed to be opposition to doing this on the part of the U.S. organizers of the expedition.

In addition to the expeditions, other efforts should be pursued more aggressively, eg, with the Russian Navy, to try to get much better information about the state of dumped radioactive materials, as well as about the general nuclear waste disposal problem. If future dumping of radioactive waste in violation of the London Convention (discussed below) is to be avoided, such information, and assurances, regarding the Russian Navy's plans for its nuclear waste are needed. Large amounts of naval nuclear waste are currently stored in ocean-side land-based sites in the Arctic and the Far East and decommissioned nuclear submarines are lined-up along the shores of several fjords on the Kola peninsula and near Vladivostok. Scientific and/or technical assistance in dealing with the Russian Navy's nuclear waste problem could significantly increase the likelihood of alleviating concerns that sea dumping of naval nuclear waste will be continued.

Retrieval and Other Remedial Measures

While the true extent of dumping, as well as the real and potential impacts of such dumping on the Arctic Ocean and region, requires ongoing attention, issues related to retrieval and remediation, more generally, merit much greater focus than has been given, to date.

The International Atomic Energy Agency (IAEA) has initiated the International Arctic Seas Assessment Project (IASAP) to assess the risks to human health and the environment associated with the radioactive wastes dumped in the Kara and Barents Seas, and to advise on possible remedial actions. This project was launched at the meeting on Assessment of Actual and Potential Consequences of Dumping of Radioactive Waste into Arctic Seas, held in Oslo during February 1993. The IASAP is set to be completed in 1996.

While the IASAP is open to experts from all IAEA Member States, non-governmental organizations (NGOs) such as Greenpeace and the Inuit Circumpolar Conference (ICC) have not been permitted to participate in this project thus far. This regrettable situation mirrors, as a general rule, scientific deliberations carried out over the years by IAEA, other international agencies and the international scientific community, and should be corrected. A recent exception to that "closed door" rule has been the meetings of the London Convention's Inter-governmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD), where Greenpeace has contributed to the deliberations.

While the IASAP program does address retrieval and other remedial measures, this work is to be the subject of only one of the four IASAP working groups which is also to consider impact assessments (the other three working groups focussing on the source terms, existing environmental concentrations and transfer mechanisms and models), and the first meeting of technical experts on remedial measures is set to take place only in Spring 1994. It must be questioned, therefore, whether retrieval and other remedial measures are being given sufficient priority in the programs that have been established already.

In Greenpeace's view, consideration of retrieval and other remedial measures must be put to the forefront of any program relating to the Soviet and Russian dumping. This is consistent with the fact that, as recognized in a report of the Russian Federation to the London Convention in 1993, the Soviet and Russian radioactive waste dumping operations breached technical and scientific criteria contained in the IAEA's "Definition and Recommendations" regarding radioactive substances. It is also in line with the emphasis placed on intervention measures by the 15th Consultative Meeting of the London Convention, which requested (LC 15/16, para 11.33.5):

> The International Atomic Energy Agency and the Russian Federation to indicate scientific and technical measures to reduce, as much as possible, any significant risk including remedial actions such as capping, retrieval and storage on land.

Clearly, retrieval of the dumped wastes offers the greatest potential for averting risk to the marine environment from eventual release and dispersion of radionuclides. Therefore, in Greenpeace's view, retrieval should be the preferred option and ultimate goal of all remedial activities in this context. Illustrative of just one of the scientific and technical problems inherent to the sea disposal option, however, it is also clear that in some cases retrieval might entail unacceptable risks to the marine environment, to workers, or both. In such cases, and preferably as an interim solution only, other remedial measures such as capping may be the most appropriate management option.

However if retrieval and other remedial measures are to be deployed in a timely manner, it will be necessary to shift the focus of efforts currently in progress away from largely theoretical modelling and risk assessment to more directly utilizable research. Urgent information is needed on the current condition of the waste packages both in order to establish priorities for intervention and to allow opportunity for the development of intervention techniques. For this purpose, a detailed and systematic program of retrieval and other remedial measures needs to be elaborated and implemented.

Although a significant proportion of the Soviet dumping was conducted prior to the entry into force of the London Convention in 1975, it also is recognized in the 1993 report, presented by the Russian Federation to the London Convention, that the Soviet Union and the Russian Federation have violated the provisions of the Convention. The importance of maintaining the credibility of the London Convention as an instrument of marine environment protection means that intervention to redress breaches of the Convention's provisions must be required of Contracting Parties. In the case of the Soviet and Russian dumping of radioactive wastes, this should clearly involve retrieval as a first option.

For these and other reasons, strengthened support should be given to initiatives focused on retrieval and remediation -- in programs and fora such as the International Arctic Seas Assessment Project (IASAP), Arctic Monitoring and Assessment Program (AMAP) and London Convention. Moreover, as alluded to earlier, those types of fora, among others, should provide effective opportunities for NGO participation, e.g., access to meetings and working groups, as well as timely receipt of pertinent documentation.

WHOI Conference (June 7-9, 1993) on Radioactivity and Environmental Security in the Arctic and North Atlantic Oceans

In early June, I and a Greenpeace International colleague, Joshua Handler, participated in a Conference at the Woods Hole Oceanographic Institution (WHOI), at which issues related to the focus of this hearing were given special consideration. We were impressed by the diversity and detail as presented in the prepared papers, and in discussions that occurred in various working groups.

Given Charles Hollister's participation in this hearing, I look forward to hearing his comments regarding that Conference, including its results. For me, and for several other participants, despite the refreshing exchange of views reflected by the papers, formal and informal discussions, a major disappointment was the closing "Statement", prepared by the Conference conveners for a press conference on June 10, 1993. That press conference Statement gave the mistaken impression that the environmental and human health risks of radioactive contamination in the Arctic are minimal, at worst.

That impression was very troubling, given the generally accepted view that pertinent data is sparse to nonexistent, and that systematic monitoring, surveys, or risk assessments have not been conducted. (See, e.g., letters by J. Diamante and R. Dyer; and by M. Champ). In contrast with that press conference Statement, the more recent Kirkenes Conference, referenced earlier, as well as the Arctic Ministerial Conference and July 1993 London Convention/IGPRAD conclusions, both discussed below, address the situation in the Arctic in ways that appear to be much more consistent with what is known, and not known.

Second Ministerial Conference (Sep. 14-16, 1993) on the Protection of the Arctic Environment

The recent, high-level meeting of government Ministers in Nuuk, Greenland at the Second Ministerial Conference on the Protection of the Arctic Environment is one indication of ongoing, special interest in the Arctic. For example, the preamble of the "Declaration" adopted at that Conference by the U.S. and seven other Arctic countries, while not mentioning radioactive contamination or other particular threats, contains such statements on behalf of the Ministers as:

> Recognizing the special role and responsibilities of the Arctic Countries with respect to the protection of the Arctic environment,
>
> Acknowledging that the Arctic environment consists of ecosystems with unique features and resources which are especially slow to recover from the impact of human activities, and as such, require special protective measures,
>
> Further acknowledging that the indigenous people who have been permanent residents of the Arctic for millenia, are at risk from environmental degradation, [and]
>
> Determined, individually and jointly, to conserve and protect the Arctic environment for the benefit of present and future generations, as well as for the global environment,....

In the "Report" of the Ministerial Conference, radioactive contamination of the Arctic was one of the important topics addressed. In relation to the Arctic Monitoring and Assessment Program (AMAP), the report states that (p. 3):

> The concentration levels of radionuclides in the Arctic Ocean which have been observed at the present time are generally low and do not appear to pose a widespread risk at present. But knowledge of sources and releases is insufficient and assessments of future consequences cannot be performed at this stage. There is significant concern with regard to the risks associated with potential releases of radionuclides into the environment from different sources, including dumped radioactive materials and wastes, run-off, leakages and accidental releases. Authorities thus agree that additional investigation is necessary, and studies should continue.

In addition, in a special section of the Report specifically on radioactive pollution, the Ministers agreed that their governments will, among other things:

> ensure that no disposal of radioactive waste or material will be made in Arctic waters in violation of provisions of the London Convention (1972); they shall work and co-operate to provide in the nearest possible future conditions for a ban on all dumping of radioactive waste in the Arctic waters; taking into account the revisions of the London Convention;

> initiate action to prevent further increase in activity levels of anthropogenically-derived radionuclides, irrespective of sources, and to reduce such levels, in order to keep the contaminations as low as reasonable achievable; [and]
>
> initiate clean-up programs for contaminated areas, as appropriate.
>
> The Ministers decided to request AMAP (Arctic Monitoring and Assessment Programme), in co-operation with appropriate international and national agencies
>
> - to establish reliable and comprehensive systems for identification and characterization of present and potential sources of significant radioactive contamination and for monitoring levels of such contamination;
>
> - to establish data bases of sources, type and levels of radionuclide contamination of the atmospheric, the aquatic and terrestrial environments of the Arctic and Northern areas; [and]
>
> - to perform a long term assessment of potential releases to the environment of radioactive materials (e.g. from nuclear installations, waste disposal sites, and contaminated regions), and to improve risk prediction capabilities.
>
> Based on i.a. the AMAP risk assessment, the Ministers agreed that their respective Governments would, as appropriate, undertake measures to reduce environmental threats.

Although much attention has been focused on the disposal of racioactive waste by the former Soviet Union and by Russia, the U.S. has not completed or made public any comprehensive inventory of its nuclear operations and radioactive dump sites in the Arctic. As an example, it was ironic that the Cape Thompson/Project Chariot nuclear waste experiment conducted in 1962 came to public attention only in August 1992 in relation to the U.S. Senate Select Committee on Intelligence hearing on Arctic nuclear waste dumping at Novaya Zemlya. Other potential sources of radiation contamination by the U.S. include the 49 DEW line sites in Alaska, radioactive thermal generators (RTGs), leaks from the reactor at Fort Greely, Alaska, and naval nuclear submarines operating in the Arctic.

More broadly, there has never been a comprehensive assessment of the cumulative health effects to Arctic indigenous peoples from their known exposure to high levels of radionuclide fallout associated with decades of nuclear testing. Clearly, the cumulative effects from potential multiple exposure routes must be seriously investigated, since indigenous peoples depend directly on subsistence resources for their survival. In this regard, the Inuit Circumpolar Conference passed a resolution over a decade ago calling for a nuclear-free Arctic homeland. In a 1993 report, the Alaska State Emergency Response Commission noted that the ICC resolution:

> was designed when the concern of a nuclear war with nuclear-powered submarines having dog fights beneath the polar ice cap was very likely. Now the threat seems to be from past practices of poor management and potential failure of nuclear power systems, but the results would be the same: the loss of their homeland.

Given the participation of David Colson, Deputy Assistant Secretary for OES, in this hearing -- who served as head of delegation for the U.S. at that Ministerial Conference -- I am confident his testimony will address in more detail radioactive contamination matters related to that meeting. The above portions of the Declaration and Report are mentioned, however, because they fully support the scientific concerns and recommendations raised in earlier portions of my testimony. Moreover, such statements, in combination with concerns regarding U.S. activities, strongly suggest that much more needs to be done by the U.S. in addressing its contribution to radioactive contamination of the Arctic and its peoples.

Regarding the Ministerial Conference's reference to expedited consideration of a ban on radioactive waste dumping in the Arctic Ocean, from Greenpeace's perspective, while we can understand the desire of some governments to "tak[e] into account the revision of the London Convention", given the special considerations applying to the Arctic, the Ministers should have pledged themselves to a full ban at that Conference. Prohibitions on radioactive waste dumping have been agreed to in regional seas programs in other areas of the world -- e.g, the South Pacific, where the U.S. joined other countries in the region in adopting such a ban on radioactive waste dumping at sea, including seabed emplacement; and the Northeast Atlantic, as per the 1992 Paris Convention. In our view, the reasons for adopting a ban in the Arctic Ocean -- such as those given by the ICC, above, among others -- are at least as compelling as they were for those regions, if not more so.

16th Consultative Meeting (Nov. 8-12, 1993) of the London Convention

As indicated in Circular Letter No. 1690, of August 6, 1993, by the Secretariat of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 ("London Convention" or "LC"), the 16th Consultative Meeting is being asked to make a decision on a proposal to prohibit permanently the dumping of intermediate- and low-level radioactive wastes in the world's oceans -- including the Arctic Ocean. Other amendment proposals also will be addressed, but radioactive waste dumping will be the most visible issue.

As alluded to in the recent Report of the Arctic Ministerial Conference, governments linked their support for a ban on radioactive waste dumping in the Arctic Ocean to the amendments that will be adopted at the 16th Consultative Meeting. For that reason, some of the findings and recommendations relevant to the impending LC decision are pertinent to this hearing.

Perhaps most pertinent is the "Final Report" of the Inter-Governmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD) which was adopted by consensus, in particular its concluding "Final and Comprehensive Statement." The content of that Statement, when compared with the far more narrowly focused conclusions of a 1985 Panel of Experts, reflects how the international community's understanding of its responsibilities towards the global environment, and its perception of environmental risks and precautionary action, have evolved since 1983, when radioactive waste dumping at sea was first suspended by an LC voluntary moratorium.

IGPRAD correctly notes, in para. 2 of its concluding statement, that certain definite trends exist such as the growing awareness within the national and international communities that new and more effective measures are needed to protect the global marine environment. IGPRAD rightly depicts language in the Earth Summit's Agenda 21 as one significant indicator of such trends, in particular the call for LC Parties to "expedite work to complete studies on replacing the current moratorium on disposal of low-level radioactive wastes at sea by a ban...." (22.5b).

IGPRAD's scientific and technical conclusions also identified several characteristics of ocean dumping which reflects its comparative disadvantage with other disposal and storage options. In particular, those conclusions reference the "diffusability of the waste radionuclides in sea water which would result in the transboundary transfer of these radioactive materials"...and the "comparative difficulty of monitoring radioactive waste packages dumped at sea...together with the relative difficulty of retrieval", as being "a necessary part of any assessment of the sea disposal option" (para. 4). Regardless of complementary reasons of a legal, political and social nature which also favor a ban, those scientific considerations provide a strong basis for prohibiting further radioactive waste dumping in the Arctic, and elsewhere in the world's oceans.

While the Clinton Administration has not yet made a final decision as to the U.S. position on the proposed amendment dealing with radioactive waste dumping, Greenpeace and the environmental community, generally, strongly support EPA's position favoring a permanent ban, as articulated by EPA Administrator Carol Browner in a July 2, 1993 letter to Secretary of State Warren Christopher. It is encouraging to note that most other federal agencies, with the notable exception of the Dept. of Defense, share EPA's views.

As is well known, in practice, the U.S. last permitted radioactive waste dumping in the 1960s. Given amendments to the 1972 Ocean Dumping Act, in particular in 1983 and 1988, domestic law came into line with practice, effectively prohibiting such dumping at sea. In early November, the United States has the opportunity to join many other countries within the London Convention in formally banning radioactive waste dumping at sea, globally -- an environmentally sound step forward that will benefit the Arctic and other marine areas. In this regard, it is Greenpeace's hope that Members of this Subcommittee and the full Committee on Merchant Marine and Fisheries will urge Administration officials to support a permanent ban, playing a leadership role within the international community in achieving that important, long overdue action.

Conclusion

Throughout its history, the Merchant Marine and Fisheries Committee has played a central role within the U.S. government in addressing and shaping U.S. law and policy on ocean and coastal issues. For radioactive waste dumping, over the years that role has involved numerous hearings and legislative proposals on past dumping, and proposed dumping. This hearing represents an important continuation of your Committee's interest in this issue. Given the unfolding information on radioactive contamination of the Arctic Ocean, your Subcommittee's efforts to examine and focus attention on this important issue are very encouraging.

Mr. Chairman, I would be happy to answer any questions that you or other Members of the Subcommittee might have. Thank you.

REFERENCES

Browner, C. (Admin. of U.S. EPA), Letter to Sec. of State W. Christopher, July 2, 1993.

Brown, R. (Sec. of Commerce), Letter to Sec. of State. W. Christopher, May 21, 1993.

Champ, M., Letter to H. Livingston, Chair of June 7-9, 1993 WHOI Conference on Radioactivity and Environmental Security in the Oceans, July 6, 1993.

Curtis, C., "The London Convention and Radioactive Waste Dumping at Sea: A Global Treaty Regime in Transition," Proceedings of the Woods Hole Oceanographic Institution Conference on "Radioactivity and Environmental Security in the Oceans: New Research and Policy Priorities in the Arctic and North Atlantic," pp. 541-555, June 8, 1993.

Diamonte, J., and Dyer, R., Letter to H. Livingston, Chair of 7-9 June 1993 WHOI Conference on Radioactivity and Environmental Security in the [Arctic and N. Atlantic Oceans, July 7, 1993.

Greenpeace, "Nuclear Threats in the Arctic" (pp. 102-104), included in "Oil in Arctic Waters: The Untold Story of Offshore Drilling in Alaska, prepared by Pamela Miller and Dorothy Smith, January 1993.

Greenpeace International, "Ocean Dumping in the USSR", Submission to the London Convention, LDC/IGPRAD 4/INF.5, 1991.

Greenpeace International, "Necessary Correction to IAEA's Inventory of Radioactive Wastes in the Marine Environment: Soviet/Russian Dumping Activities", London Convention, LDC 15/INF. 18, November 4, 1992.

Handler, J., Letter to Secretary of the Navy J. Dalton, September 20, 1993.

Handler, J., "Radioactive and Other Environmental Threats to the United States and the Arctic Resulting from Past Soviet Activities," Hearing before the U.S. Senate Select Committee on Intelligence, Fairbanks, Alaska, August 15, 1992.

Handler, J., "Radioactive Pollution from Accidents Involving Nuclear-Powered Vessels: Problems and Solutions," Proceedings of the Woods Hole Oceanographic Institution Conference on "Radioactivity and Environmental Security in the Oceans: New Research and Policy Priorities in the Arctic and North Atlantic," pp. 557-572, June 8, 1993.

IAEA, IASAP Progress Report no. 1, July 1993

IAEA, "Definition and Recommendations for the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972", Safety Series No. 78, 1986.

IGPRAD, "Final Report," Inter-Governmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD), London Convention, (LC/IGPRAD 6/5), August 1993.

Kirkenes, Norway, "A Survey of Artificial Radionuclides in the Kara Sea: Final Results from the Russian-Norwegian 1992 Expeditions to the Barents and Kara Seas," Joint Russian-Norwegian Expert Group for Investigation of Dumped Radioactive Waste in the Barents and Kara Sea, Draft version, August 1993.

London Convention, Circular Letter No. 1690 regarding Denmark's proposed amendments on radioactive waste, inter alia, August 6, 1993.

London Convention, Report of 14th Consultative Meeting, LDC 14/16, para. 11.43, 1991.

London Convention, Report of 15th Consultative Meeting, LC 15/16, paras. 11.1-11.35, 1992

MacKenzie, D., "Row surfaces over sunken [Komsomolets] nuclear sub," New Scientist, p. 7, September 18, 1993.

Romanenkova, V., "Plans to Seal the Bow of Sunken Komsomolets Submarine," ITAR-TASS correspondent, September 16, 1993.

Romanenkova, V., "Radiation Situation in Kara Sea Practically Normal," ITAR-TASS correspondent, September 16, 1993.

Russian Federation, "Facts and Problems Related to Radioactive Waste Disposal in Seas Adjacent to the Territory of the Russian Federation", Yablokov Commission "Russian White Book" report to Pres. Yeltsin, submitted to London Convention, LC/IGPRAD 6/INF.4, 1993.

Russian Federation,Government Decree No. 710, July 23, 1993.

WGBH, "Out of Sight, Out of Mind," Documentary on radioactive waste dumping at sea, with special emphasis on Massachusetts Bay, produced by Seth Reuben, May 1993.

Woods Hole Oceanographic Institution, Conference on "Radioactivity and Environmental Security in the Oceans: New Research and Policy Priorities in the Arctic and North Atlantic," Proceedings (647 pp.) and closing press conference Statement, June 7-10, 1993, pp. 541-555, June 8, 1993.

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December 10, 1993

Honorable Solomon P. Ortiz, Chair
Subcommittee on Oceanography, Gulf of Mexico
and the Outer Continental Shelf
Committee on Merchant Marine and Fisheries
U.S. House of Representatives
House Annex 2 (FHOB), Room 575
Washington, D.C. 20515

Re: Follow-up Submission Concerning September 30, 1993 Hearing
on Radioactive Contamination in the Arctic Ocean

Dear Chairman Ortiz, and other Members of the Subcommittee:

I am grateful for this opportunity to expand upon and clarify the Statement which I made before the Subcomittee on September 30, 1993, at your hearing on radioactive contamination in the Arctic Ocean.

This letter, and attachments, briefly highlight several matters pertinent to the hearing, including the incident involving dumping of radioactive wastes by the Russian Federation in the Sea of Japan in mid-October 1993, decisions adopted within the London Convention forum in early November 1993 (Attachment A), and my post-hearing answers to questions that you asked me to address (Attachment B).

I am sure that Subcommittee Members agree that the dumping of the radioactive wastes in the Sea of Japan by the Russian Federation in mid-October, 1993, makes the timing of the Subcommittee's examination of the waste management problems confronting the Russian Federation, and especially its Navy, particularly apt.

I also am certain that Subcommittee Members will agree that the radioactive waste-related decisions taken at the most recent 16th Consultative Meeting of the Contracting Parties to the London Convention (November 8-12, 1993) also makes the timing of the Subcommittee's hearing propitious. As you know, on November 12, 1993, the U.S. and 36 other State parties to the LC adopted a global, permanent ban on radioactive waste dumping at sea.

Appended to this letter as Attachment A is copy of the amendment resolution that was adopted by the London Convention State parties on this important subject. That amendment resolution includes a description of the specific changes that will be made to the annexes of the Convention -- the most important of which is that low and intermediate-level radioactive wastes now join high-level radioactive waste as Annex I substances that are prohibited from being dumped in any of the world's oceans. Also included with that attachment is a complete listing of those States that voted for the amendment, those who abstained, and those who were not present at the time that historic decision was made; as well as a copy of a New York Times article on November 13, 1993, concerning the decision.

While no State voted against the amendment, five of the Convention's 71 State parties -- Brussels, China, France, Russian Federation, and the UK -- did abstain from the decision when a recorded vote was taken. Those five States now have 100 days from the date of the decision to file a declaration of non-acceptance if they decide they are not willing to be bound by the ban. (Any other State party could likewise file such a declaration, but no others are expected to do so.) It is Greenpeace's fervent hope that those five countries will agree that the amendment banning radioactive waste dumping at sea is in their best interests, as well as in the best interests of the oceans, and that they will not file any declaration within the 100-day period which ends on or about February 20, 1994.

Also annexed to this letter as Attachment B are my responses to the 10 questions you asked me to address. For the record, I would like to acknowledge the substantial assistance provided by Simon Carroll, Nuclear Advisor, Political Unit, Greenpeace International, and by Joshua Handler, Researcher, Nuclear Free Seas Campaign, Greenpeace International, in preparing answers to your questions. The scientific and technical nature of most of those questions far exceeded my grasp of the situation, and I am indebted to my colleagues for their mastery of these issues.

Again, thank you for the opportunity to participate in the timely and important topic addressed by your September 30th hearing. If I or my organization can be of further assistance, please feel free to contact me.

Sincerely,

Clifton Curtis
Oceans Advisor, Political Unit
Greenpeace International

Attachments

ATTACHMENT A

On November 12, 1993, at the 16th Consultative Meeting of the Contracting Parties to the London Convention (LC16), the following resolution and related annex was adopted. Following the resolution and annex is a listing of the 37 LC Parties (including the U.S.) who voted for the resolution, the 5 who abstained, and the 4 who were absent at the time of the vote. (No Party voted against the resolution.) Also included is a copy of the New York Times article of November 13, 1993, which reports on the decision made by the LC Parties with respect to this issue.

RESOLUTION LC.51(16)

AMENDMENTS TO THE ANNEXES TO THE CONVENTION ON THE PREVENTION OF MARINE POLLUTION BY DUMPING OF WASTES AND OTHER MATTER, 1972 CONCERNING DISPOSAL AT SEA OF RADIOACTIVE WASTES AND OTHER RADIOACTIVE MATTER

THE SIXTEENTH CONSULTATIVE MEETING,

RECALLING Articles I and II of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter which state, *inter alia*, that Contracting Parties shall individually and collectively promote the effective control of all sources of pollution of the marine environment and that they shall harmonize their policies to prevent marine pollution caused by dumping,

BEING AWARE that the dumping of high level radioactive wastes or other high level radioactive matter is prohibited under Article IV in connection with Annex I, paragraph 6 of the Convention,

NOTING resolution LDC.21(9) on the suspension of all dumping at sea of radioactive wastes and other radioactive matter and recognizing that, such suspension shall continue until the entry into force of the amendment to Annex I, paragraph 6 of the Convention,

NOTING ALSO that the International Atomic Energy Agency (IAEA) is the competent international body to define waste and other matter considered to be radioactive for purposes of regulatory control under the Convention and has been requested by Contracting Parties to develop quantitative limits for *de minimis* (exempt) levels of radioactivity,

RECOGNIZING that in the interim, the Parties shall be guided by IAEA Safety Series 78 and 89, and decisions and recommendations taken at the Consultative Meetings,

NOTING FURTHER that amendments to the Convention relating to the issue of inclusion of sub-sea-bed repositories accessed from the sea in the definition of "dumping" are under consideration by the Contracting Parties,

RECALLING ALSO resolution LDC.44(14) on the application of a precautionary approach to environmental protection within the framework of the London Convention 1972, BEING ALSO AWARE of the encouragement by UNCED Agenda 21, Chapter 22.5(b) to the Contracting Parties to expedite work to complete studies on replacing the current voluntary moratorium on disposal of low level radioactive waste at sea by a ban, and

NOTING FURTHER the conclusions and the options on disposal at sea of radioactive waste as contained in the final report (LC/IGPRAD 6/5) of the Inter-governmental Panel of Experts on Radioactive Waste Disposal at Sea which was established on the basis of resolution LDC.28(10) and expressing its appreciation to the experts involved in the preparation of this final report,

HAVING ADOPTED amendments to Annex I to the Convention by resolution LC.49(16) concerning phasing out sea disposal of industrial waste,

ADOPTS the following amendments to the Annexes to the Convention in accordance with Articles XIV(4)(a) and XV(2) thereof:

(a) amendment to Annex I, paragraphs 6, 8, 9 and insertion of a new paragraph 12; and

(b) amendment to Annex II, section D

the texts of which are set out in the attachment to this resolution,

REQUESTS the Secretary-General of the International Maritime Organization to inform the Contracting Parties of the above mentioned amendments in accordance with Article XV(1)(b) of the Convention,

REAFFIRMS that, with respect to any Party as to which the amendment to paragraph 6 of Annex I is not in force, the suspension of all dumping of radioactive wastes and other matter established by resolution LDC 21(9) shall continue until the entry into force of the amendment to Annex I, paragraph 6 of the Convention,

AGREES that the disposal of radioactive wastes and other radioactive matter into sub-sea-bed repositories accessed from the sea in accordance with resolution LDC.41(13) is suspended until such time as the Parties determine otherwise, noting that whether such disposal is "dumping" within the meaning of the Convention is under consideration by the Consultative Meeting,

RESOLVES FURTHER that Contracting Parties shall endeavour to co-operate in assisting countries with special problems relating to the safe disposal of radioactive wastes to meet effectively their international obligations under the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.

ATTACHMENT

ANNEX I

1 The existing text of paragraph 6, Annex I, is replaced by the following:

"6 Radioactive wastes or other radioactive matter."

2 The following phrase is added at the beginning of paragraph 8, Annex I:

"8 With the exception of paragraph 6 above, ..."

3 The second sentence of the existing text, paragraph 9, Annex I, is replaced by the following:

> "Paragraph 6 above does not apply to wastes or other materials (e.g. sewage sludges and dredged materials) containing de minimis (exempt) levels of radioactivity as defined by the IAEA and adopted by the Contracting Parties. Unless otherwise prohibited by Annex I, such wastes shall be subject to the provisions of Annexes II and III as appropriate."

4 The following text is added to Annex I as a new paragraph 12:

"12 Within 25 years from the date on which the amendment to paragraph 6 enters into force and at each 25 year interval thereafter, the Contracting Parties shall complete a scientific study relating to all radioactive wastes and other radioactive matter other than high level radioactive wastes or matter, taking into account such other factors as the Contracting Parties consider appropriate, and shall review the position of such substances in Annex I in accordance with the procedures set forth in Article XV."

ANNEX II

The present text of Annex II, section D is deleted and the subsequent sections are redesignated accordingly.

***

Voting Breakdown for radioactive waste resolution/amendments:

* Those who voted for (37 countries): Argentina, Australia, Brazil, Canada, Chile, Cyprus, Denmark, Egypt, Finland, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Mexico, Morocco, Nauru, Netherlands, New Zealand, Nigeria, Norway, Oman, Papua New Guinea, Philippines, Poland, Portugal, Solomon Islands, South Africa, Spain Sweden, Switzerland, Ukraine, United States, Vanuatu

* Those who voted against: None

* Those who abstained (5 countries): Belgium, China, France, Russian Federation, United Kingdom

* Those who were absent (4 countries - registered, but not there at time of vote): Cuba, Jamaica, Panama, Zaire

* Those who are among the 70 LC Parties, but who did not attend the Meeting (23 countries): Afghanistan, Antigua & Barbuda, Belarus, Cape Verde, Cote D'Ivoire, Croatia, Dominican Republic, Gabon, Guatemala, Haiti, Honduras, Hungary, Jordan, Kenya, Kiribati, Libya, Monaco, Seychelles, Slovenia, St. Lucia, Suriname, Tunisia, United Arab Emirates

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The New York Times

SATURDAY, NOVEMBER 13, 1993 p. 7

NATIONS BACK BAN ON ATOMIC DUMPING

Russia and 4 Others Abstain on Vote to Protect Oceans From Low-Level Waste

By **DAVID E. PITT**

Capping a series of actions hailed by environmentalists as a turning point in the protection of the world's oceans, the United States and 36 other governments voted yesterday to impose a permanent, legally binding ban on the dumping of all types of radioactive waste at sea.

The vote to ban dumping of low-level radioactive wastes came at a meeting in London of 42 of the 71 nations that signed a 1972 treaty on ocean dumping. Five of the countries represented at the meeting — Russia, Britain, France, China and Belgium — abstained from the vote.

On Thursday the signers of the treaty also approved two less intensely debated measures, approving permanent prohibitions on ocean dumping of toxic industrial wastes and waste incineration at sea. The agreement's "black list" of prohibited materials already includes highly radioactive wastes.

Diplomats say the actions will transform the treaty — known as the London Convention — from an agreement regulating marine dumping to one aimed at preventing the practice whenever there is reasonable doubt about its ecological soundness.

Modest Step, Big Problem

In terms of the overall problem of ocean pollution, the bans constitute a modest step: deliberate dumping of nuclear and toxic industrial wastes at sea constitutes only about 10 percent of the total that enters the ocean. Up to 80 percent originates from such sources as raw sewage, airborne wastes, and agricultural runoff of pesticides and fertilizer.

But environmental groups believe that the governments' actions in London this week are a sign that they may eventually come to grips with the much larger problem of land-based marine pollution, which Clifton Curtis, a treaties expert with Greenpeace International, described as "far more complicated in technical, legal, political and economic terms."

"What they did here is a sign of a real commitment to view the oceans very differently than before," Mr. Curtis said in a telephone interview from London, where Greenpeace — which began campaigning for permanent dumping bans 15 years ago — was monitoring the conference. "It sends a very positive signal."

Moscow says it needs aid to stop dumping at sea.

Russia Seeks Disposal Aid

All five countries that abstained from the vote have the right to refuse to comply with the ban. The measure, which replaces a 10-year-old, nonbinding moratorium, is to take effect in 100 days, and includes a provision for a scientific review after 25 years.

Russia, which has been dumping nuclear wastes into the ocean for decades, said it would have to resume dumping low-level radioactive garbage after 18 months unless it receives assistance from the West to build more land-based storage areas.

The plea for aid was dismissed as unconvincing by the chief American delegate, David A. Colson, who noted that Russia spends "enormous sums of money" on its nuclear fleet.

"You will not convince me, and you will not convince the American people, that if the Russian Government so chose, it could not reallocate its priorities and immediately build and quickly have in place adequate storage and processing facilities," Mr. Colson told delegates on Thursday.

Adoption of the ban comes less than a month after a Russian Navy tanker, shadowed by a Greenpeace vessel, pumped more than 900 tons of low-level waste into a prime squid-fishing ground in the Sea of Japan. The episode, just days after the Japanese and Russian Governments had pledged to begin a new era of cooperation, set off a storm of protest. Soon after, on Oct. 21, Japan announced that it would support a permanent ban.

Clinton Shifts U.S. Policy

On Nov. 1, a Clinton Administration official disclosed that, after nearly a year of deliberations, it had decided to reverse American policy and also support such a ban. Participants in the London meeting said the shift, championed by the Environmental Protection Agency and the National Oceanic and Atmospheric Administration, was a decisive factor in yesterday's vote.

The decision in London follows years of controversy over the suspected — but still largely unproven — dangers of dumping of low-level radioactive wastes on marine ecosystems. Proponents of the ban argued that the wastes could be retransmitted to humans through the food chain. They also warned that it was risky to dump radioactive material without means to monitor and, if necessary, retrieve it.

The ban, originally proposed by Denmark, is in line with a measure approved at the so-called Earth Summit in Brazil last year, when 172 governments urged the treaty signatories to consider banning low-level dumping as a precaution.

But Britain and France, which fought an 11th-hour battle for a compromise short of a permanent ban, questioned whether low-level waste dumping posed a real danger, and complained that a permanent prohibition would complicate the problem of what to do with growing accumulations of low-level wastes, much of it from decommissioned submarines, nuclear power plants and hospitals.

ATTACHMENT B

WRITTEN ANSWERS OF
CLIFTON CURTIS, OCEANS ADVISOR,
POLITICAL UNIT, GREENPEACE INTERNATIONAL

TO FOLLOW-UP QUESTIONS FROM
THE SUBCOMMITTEE ON OCEANOGRAPHY
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES

CONCERNING
RADIOACTIVE CONTAMINATION IN THE ARCTIC OCEAN

- December 10, 1993 -

Question 1: Mr. Colson mentioned in his testimony that the Russians are proposing to seal some of the torpedo tubes on the KOMSOMOLETS. In the light of other testimony this seems to be an unnecessary step. What do you believe is the reasoning behind this decision?

The data on condition of the Komsomolets is far from comprehensive, and the assessments of the potential consequences of the dispersal of radionuclides from the wreck are also based on much simplification and are subject to large uncertainties. However, the results available to date from a number of expeditions show that there is already noticeable deterioration of the submarine, and that radionuclide concentrations are elevated around the hull. An expedition by the R/V Akademik Mstislav Keldysh and the R/V Ivan Kruzenshtern in 1991 showed that corrosion in torpedo tube number 2 had increased noticeably, and the Yablokov Report [1] states that release of plutonium from the nuclear warheads could be expected as early as 1995-1996.

It is true that the significance of these results is interpreted differently in some of the testimony that the Subcommittee heard. However, and in stark contrast to Dr. Hollister's statement to the Subcommittee, a decision to undertake remediation measures would appear to acknowledge the uncertainties inherent to the situation and therefore the need to apply a precautionary approach.

The Yablokov Report discusses the Komsomolets submarine at some length, and the discussion provides some insight into why retrieval and other intervention designed to mitigate any release of radionuclides has been given a high priority. The Yablokov Report states:

> The area where the accident took place is among the most biologically productive in the world's oceans, and is of special economic importance. It falls within the sphere

> of interests of Russia, Norway, Sweden, Great Britain, and Iceland. Even minimal transport of radionuclides (fission products and transuranium elements) up the food chain from seawater to plankton to fish could have grave political and economic consequences.

In this latter respect, the Yablokov Report cites research by the Polar Institute of Marine Fishery and Oceanography which shows that commercial fish is expected to be contaminated at twice the allowable limit for Pu-239, and heavy economic damage could be thus expected. In aiming to seal the tubes or adopt other remedial measures, the Russians would in this case be acting in accord with the conclusions of the London Convention, which at its 15th Consultative Meeting emphasized the importance of retrieval and other remediation measures for radioactive wastes in the Arctic, and more generally with principles and obligations outlined in response to Question 2 below.

Question 2: What are the obligations of the Russian Federation with respect to radioactive waste dumping in the Arctic under the London Convention and under international environmental law?

2.1 Obligations Arising Under the London Convention

Put simply, the London Convention completely prohibits the dumping of all types of radioactive wastes in the Arctic. In its preamble, articles and annexes, the London Convention repeatedly emphasizes protection of the marine environment as its primary objective. The basic philosophy of the Convention is that the nations of the world, along with the UN agencies and other international organizations, will work together to ensure that the marine environment becomes safe from the dangers of dumping.

The dumping of high-level radioactive wastes or other high level radioactive matter at sea is prohibited under the London Convention. It should be noted that the provisions concerning high-level wastes apply not only to the Arctic, but to any sea dumping operation by a Contracting Party. The task of defining high-level wastes and other matter unsuitable for sea dumping was assigned to the International Atomic Energy Agency by Annex I(6) of the London Convention. The current definition of high-level wastes is:

> (1) Irradiated nuclear fuel; liquid wastes from the first extraction cycle of chemical reprocessing of irradiated nuclear fuel, or equivalent processes; and solidified forms of such waste; and
>
> (2) any other waste or matter of activity exceeding: (a) 5x10.(E-5) TBq/kg for alpha emitters; (b) 2x10.(E-2) TBq/kg for beta/gamma emitters with half-lives of greater than one year (excluding tritium); and (c) 3 TBq/kg for tritium and beta/gamma emitters with half-lives of one year or less.

Although the London Convention's current moratorium has prevented the dumping of any radioactive wastes at sea since 1983 -- other than the illegal dumping authorized by USSR and Russian Federation authorities -- the recent decision taken at the 16th Consultative Meeting to amend the Convention to formally ban any radioactive waste dumping is a very welcome and positive, next step forward. However, as noted in the introductory paragraphs of this letter, the Russian Federation and four other countries abstained from that decision, and at this time it is uncertain whether those countries will "opt out" of the ban by filing a declaration of non-acceptance.

If, regrettably, any of those countries were to file such a declaration during the 100-day period following the November 12, 1993 decision, thereafter their national authorities could issue permits under certain circumstances pursuant to Annex II for low and intermediate-level radioactive waste dumping at sea. In issuing such a special permit, though, Annex II(D) of the London Convention requires national authorities of Contracting Parties to:

> ...take full account of the recommendations of the competent international body in this field, at present the International Atomic Energy Agency.

The current "Definition and Recommendations" were published in 1986 as IAEA Safety Series No. 78 [2]. Paragraph 21(1) of the Definitions and Recommendations states, inter alia, that dumping shall be restricted to those areas of the oceans between latitudes 50 degrees North and 50 degrees South. This clearly prohibits the dumping of such wastes in the Arctic.

2.2 Obligations Arising Under International Environmental Law

The London Convention's Inter-governmental Panel of Experts on Radioactive Waste Disposal at Sea (IGPRAD) adopted its final report on the 16th July 1993 [3]. Section 5.1.1 of their report examines the legal issues relating to the dumping of radioactive wastes at sea which IGPRAD was asked to study, including:

> -- the provisions of existing conventions and international law regarding the uses of the sea relating to pollution across or outside national frontiers;
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> -- international consultative and multilateral mechanisms in particular with regard to internationally recognized duties to consult on dumping at sea;
>
> -- the obligation to monitor and mitigate the effects of dumping; and
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> -- domestic laws controlling the dumping at sea of radioactive wastes.

It was generally acknowledged by IGPRAD that there has been a sustained development of international law in the past 20 years, with a trend towards, first, restricting and controlling, second, prohibiting sea disposal of radioactive wastes on a regional basis, and later challenging the legitimacy of States' use of the high seas and the oceans' floors beyond their national jurisdiction for activities that might result in the pollution of the marine environment. Most of the IGPRAD Members considered that customary rules of international law had emerged that:

> -- States have a duty not to cause significant pollution affecting other States or the marine environment in general;
>
> -- whenever a State aims to undertake activities which may cause harmful effects on a shared material resource, there is a prior duty to notify other States and to consult them if they would be affected by such use; and
>
> -- a State has a duty to mitigate damage if it is responsible for occurrence of pollution.

One of the principal conclusions of IGPRAD's discussions was that there is a growing awareness within the national and international communities that new and more effective measures are needed to protect the global marine environment, as evidenced by the results of the 1992 United Nations Conference on Environment and Development [4].

Question 3: Do you think that the Russian Federation has released all relevant information that exists pertaining to its nuclear waste dumping in the Arctic?

The short answer is no. At the International Conference on Environmental Radioactivity in the Arctic and Antarctic held in Kirkenes (Norway) during August 1993, it was stated by members of the Russian delegation that some documents relating to the Arctic dumping are still classified, although declassification is being considered.

The participants in the International Atomic Energy Agency's International Arctic Seas Assessment Project (IASAP) have identified a whole range of areas where information is lacking or deficient. The participants in the conference in Oslo [5] stressed that priority in particular should be given to radiation and other persistence properties of materials used for protection barriers in the dumped reactors (including the nature and characteristics of the substance called "furforol"). This and other details of the nature and conditions of packaging used and the isotopic content of wastes dumped are likely to be available, and are important data for risk estimation and the prioritization of remedial measures. In addition, the detailed oceanography of the Kara Sea in particular is not well understood, and it is possible that data held by the Navy could be valuable in assessing likely movement of radioactive materials, particularly in the region of Novaya Zemlya.

More generally, access to the actual dump sites is necessary on a sustained basis if comprehensive evaluations are to be conducted and action plans are to be developed. Although access has improved, the 1993 joint Norwegian-Russian expedition did not get the requested permissions for access to all the dump sites in the Kara Sea, and a United States expedition was cancelled when permission was not forthcoming. Access to data on shore-based storage facilities and nuclear facilities on the Ob river watershed is still extremely restricted to non-existent, and is vitally necessary for a comprehensive assessment (see also question 10).

Question 4: With the new knowledge that we have, do you think that there is a need to re-evaluate the purposes and mandates of the Arctic Research and Policy Act?

The Artic Research and Policy Act, as amended in 1990 [6], is intended to provide, among other things, a "comprehensive national policy dealing with national research needs and objectives in the Arctic." The Act's "Findings and Purposes" are intended to set priorities for U.S. Arctic research policies and programs. The Act also established the Interagency Arctic Research Policy Committee, which is charged with developing and implementing such policies and programs, and the Arctic Research Commission, which is intended to serve as a public adviswory board providing strategic input on U.S. research activities.

The framework for the Act was drafted shortly after former President Reagan articulated U.S. Arctic policy in National Security Decision Directive 90 (1983). NSDD clarified and supported the activities of the interagency Arctic policy group, which is chaired by the Department of State and was formed in 1971 to facilitate the development of U.S. foreign policy in the Arctic region.

As expressed in NSDD 90, the highest priority for U.S. Arctic policy was described as "protecting essential security interests in the Arctic region." This philosophy was also incorporated into the Act, which has resulted in the disproportionate emphasis on defense-oriented research, followed closely by oil and mineral extraction-related research. This orientation also is reflected in terms of the composition of the Arctic Research Commission, which does not include representation from the environmental protection or human health communities. Although the Act includes environmental protection and human health issues as topics, the level of attention in terms of federal agency programs and funding has not begun to adequately address the ecological problems which face the region and its inhabitants.

As East-West Cold War tensions have subsided and greater attention has been directed to Arctic environmental problems, the Arctic rim states have been increasingly willing to cooperate to resolve these issues, including establishment of the Arctic Environmental Protection Strategy (AEPS) in 1991. The Strategy created four working groups: 1) the Arctic Monitoring and Assessment Program (AMAP); 2) Conservation of Arctic Flora and Fauna; 3) Emergency Prevention, Preparedness and Response; and 4) Marine Environment. Each working group has been assigned specific tasks that are designed to provide a better understanding of the state of the Arctic environment, and to develop strategies to reduce or minimize contaminants entering the region's ecosystem. The Strategy also emphasized the importance of involving the native community throughout the entire process.

When the U.S. adopted the Strategy, officials stated that the activities described within it would not require any additional U.S. funding or new programs. Although the U.S. has played an important role in shaping the Strategy and AMAP, funding for the agencies principally engaged in working group activities (State, EPA, NOAA and the Coast Guard) has not been adequate. In particular, EPA has announced its intention to discontinue its Arctic research program by FY 95, a program that has provided invaluable data for domestic purposes as well as serving as a vital component of the Arctic Monitoring and Assessment Program. If EPA abandons Arctic research, it is not clear how the U.S. will meet its responsibilities under the Strategy or assess potential threats to its own territory.

The Clinton Administration has undertaken a review of U.S. Arctic policy as a portion of the Presidential review process for global environmental issues. It is likely that a new formal statement on U.S. policy in the region will establish environmental protection as a much higher priority. Related to that effort, Vice President Gore and EPA Administrator Browner are travelling to Russia during December 1993 to discuss renegotiation of the 1972 U.S./Russian bilateral agreement on the environment, and possibly a new Arctic-specific agreement.

With these developments in mind, an updated evaluation of the 1984 Arctic Research and Policy Act should be undertaken to reflect present concerns related to the need for enhanced environmental protection in the Arctic. The Cold War has ended, leading to a new multilateral cooperative arrangement, as reflected in the AEPS. The Rio Earth Summit has given new meaning to integrating environment and development, which is extremely relevant in the Arctic context. Statutory improvements could be made in terms of providing clearer guidance for federal agency funding priorities to support research necessary to accomplish these goals. Such authority also could address the need for environmental protection and human health expertise on the Arctic Research Commission. New statutory authority also could provide a mechanism to promote public consultation and input throughout the research policy formulation process. Finally, the Arctic Research Commission's role in terms of assisting in the development of U.S. arctic research policy may need to be strengthened.

Question 5: The Yablokov report outlines some blatant and relatively recent violations of international law by the former Soviet Union. How was the report received within the current Russian scientific and military communities?

It is our impression the Russian Navy was unhappy about the publication of the report. Seemingly the Navy did not try to block its release per se, but the Navy put limits on the amount of information to be included. Why was the Navy dissatisfied? It is our impression from talking to senior naval officers about the report that: a) the Navy felt the report would arouse a lot of concern and raise criticisms of the Navy, but would not lead to any solution to the problem in the foreseeable future; b) the Navy still wishes to dump waste at sea, and the release of the report would complicate this; and c) the report represented, in the Navy's view, an unnecessary intrusion of the public into affairs which are not the public's business.

As for other parts of the Russian military, we have not detected any evidence of concern one way or the other. Ironically, Naval officers have said to us that this creates difficulties for the Navy -- the matter has not received the high-level or widespread attention in the Ministry of Defense or General Staff which would lead to greater resources for dealing with the problem.

In terms of the scientific community, the Committee should understand the report has not been widely distributed in Russia, although a lot of people know if its existence through mass media references. Copying and widely distributing information has not been and is not a strength of the Soviet/Russian bureaucracy. Nonetheless, of those scientists who have the report that we know of, they are frustrated that the Russian Navy continues to be uncooperative in helping to investigate the matter more thoroughly.

Question 6: Can you describe what is known of the integrity of the waste containers and reactors which have been dumped ? How high is the risk of significant leakage from these containers, especially considering the physical conditions which they are exposed to (including ice)? What is the likelihood of barrels and other wastes being transported by current and ice motions?

6.1 Integrity of Dumped Materials

Although it can be hoped that the 1993 joint Russian-Norwegian expedition will have resulted in real data relating to the condition of the dumped packages and reactors, at the moment there is no substantive data available. It should be noted that the widely reported 1992 joint Norwegian-Russian expedition did not have sufficient access to actual dumping sites to be able to provide useful information about the actual state of the dumped material [7].

As noted above in the answer to Question 3, the nature, condition, and performance of the packages and the material in the dumped reactors has been identified as a priority area where important data is urgently needed for the IAEA's IASAP. Many of the assumptions about leakage applied by the Russian authorities and some western scientists, assume high performance of both the packages and reactor materials themselves, as well as of the "furforol" material which was used in the reactor dumping. Anecdotal reports of packages being shot at to allow them to sink, for example, would counsel prudence in making assumptions about packaging performance until real data is made available.

6.2 The Risk of Leakage and Transport of Wastes

It is clear that with time, any package dumped at sea is likely to deteriorate and release its contents to the marine environment. Until we know more about the nature and condition of the packages and the reactors, it is difficult to assess how rapidly the Soviet and Russian material is deteriorating.

By way of comparison, we can consider the U.S. EPA results from its recovery of a number of dumped packages of radioactive wastes whose deterioration during immersion has varied widely [8]. A conservative estimate for one package that had been immersed for 15 years, was that it would take 104 years before the waste form would lose its integrity due to cement phase dissolution. Another package showed that much of the radioactive material may have leached through the waste form during the estimated 15-20 years immersion time.

It should be noted that much of the Russian dumping involves very high activity waste, such as the spent fuel, and considerable amounts are dumped at depths which makes them vulnerable to external events such as storms and damage from ice. The Yablokov Report even states there has been a report of a highly active fragment, seemingly from a fuel rod, washed up on Novaya Zemlya.

Much of the dumping around Novaya Zemlya is at depths of 20-50 meters (see Question 7 below) and Weeks [9] reports ice gouging at water depths of 50 meters based on Canadian and U.S. data. He notes that published data on this phenomenon on the Russian shelf is scarce and non-quantitative. However, Weeks stresses that some of those areas may be vulnerable to this effect, as well as being subject to strong tidal movements and, for some western Russian islands, iceberg formation.

Weeks also addresses the incorporation of dumped material into ice, and its transport over long distances. Once material is incorporated, it will be transported until the ice melts which may be thousands of kilometers and tens of years removed from the time and place of the transfer to the ice mass. He notes that suspension freezing is an effective mechanism for transferring to the ice both sediment suspended in the water column and sediment residing on the sea floor. This freezing is known to occur to depths of at least 20-30 meters, and that conditions suitable for its formation exist around Novaya Zemlya.

Without more data it is difficult to assess the effect of these phenomenon on the dumped materials, however it is clear that major disruption of packages could occur, and that the material might be subsequently dispersed. Weeks concluded that for the Arctic Ocean, if water depths are 50-60 meters or less, there are clearly effective mechanisms involving ice for gouging the sea floor to depths of up to six meters and for rupturing containers, as well as spreading material over the sea-floor or transport long distances by incorporation into ice.

Question 7: Could you please catalogue, from the information provided to this point, the wastes which have been dumped (including amounts, locations, isotopes, and half-lives)?

7.1 Intentional Dumping

The Yablokov Report states that dumping first occurred during the run-testing of nuclear submarines and the nuclear icebreaker 'Lenin'. In 1959, 600 cubic meters of liquid radioactive waste were dumped in the White Sea, and a further 100 cubic meters were dumped in the Gulf of Finland. Regular liquid radioactive waste dumping began in 1960, and solid waste dumping began in the northern and far-eastern seas in 1964.

Unfortunately little information on isotopic content radioactive waste dumped was provided in the Yablokov Report. With the solid radioactive waste, the activities presented are not comparable with figures from other countries. Apart from reactor components and reactors proper with spent fuel, the Yablokov Report explains that the original records provided to the Commission present the solid radioactive waste activity in terms of "strontium-90" equivalents, as a generalized description of different types of solid radioactive waste. The Yablokov Report states:

> Numerical values of "activity (Sr-90 equivalent)" were determined on the basis of measurements of the dose power near the solid radioactive waste mass using a simple empirical dependence, taking into consideration a priori knowledge of the radionuclide content of the solid radioactive waste mass.

7.1.1 Liquid Radioactive Wastes

Five officially chosen areas for liquid waste dumping in the northern seas were chosen between 1960-1966 by the Northern Fleet Headquarters and approved by the Navy General Command.

The total activity for liquid waste dumping in the northern seas was 903 TBq (excluding leaks from shore-based storage, and submarine accidents), and a small proportion of the dumping was conducted outside the designated areas. Dumping of these wastes is reported as occurring extremely irregularly. The dumping of liquid radioactive waste in the northern seas are distributed as follows: Baltic Sea (0.007 TBq); White Sea (3.7 TBq); Barents Sea (450 TBq); and Kara Sea (315 TBq).

It should be noted that dumping of liquid waste is not permitted under the London Convention. This is because the wastes may return rapidly to the surface where they can cause an immediate radiation hazard, and they are likely to remain at ocean depths where there is the greatest density of marine organisms, facilitating transfer of radionuclides into the marine food web. At the Conference on Environmental Radioactivity in the Arctic and Antarctic held in Kirkenes (Norway) in August this year, it was stated that the Navy had not dumped liquid waste in the northern seas in 1993. However, liquid wastes were dumped in the Sea of Japan in October of 1993.

7.1.2 Solid Radioactive Waste

As noted above, solid radioactive waste dumping was reported to have begun in 1964. In terms of volume, most of the solid radioactive waste dumped in the northern seas was low and intermediate level waste produced during the operation of Naval nuclear powered surface vessels and submarines, and the nuclear icebreaker fleet and at the respective shipyards. At the above- mentioned conference in Kirkenes, it was stated that the dumping of solid radioactive waste in the northern seas had not taken place in 1992 or 1993 and was now prohibited, although some packaged solid waste may have been dumped in the Sea of Japan in October this year. It should be noted that dumping of such waste above latitude 50 degrees north is prohibited under the London Convention.

7.1.2.1 Low and Intermediate Level Solid Waste

A total of nearly 600 TBq of low and intermediate level solid radioactive waste was dumped in 65 dumping operations. The greatest number of dumping operations of low and intermediate level waste were performed in 1967 and 1982, but the dumping operations with the greatest activity took place in 1983 and 1988. Most of the solid radioactive waste dumping in terms of volume took place in the Kara Sea, in Area 1 (Novaya Zemlya depression), and in terms of total activity, in Area 2 (Sedov Inlet).

The distribution is as follows: Area 1, 123 Tbq, 22 dumping operations (1967-1991); Area 2, 126 TBq, 8 dumping operations (1982-1984); Area 3, 75 TBq, 8 dumping operations (1968-1983); Area 4, 99 TBq, 8 dumping operations (1964-1978); Area 5, 47 TBq, 5 dumping operations (1968-1975); Area 6, 25 TBq, 7 dumping operations (1966-1981); Area 7, 8 TBq, 1 dumping operation (1972); Area 8, 68 TBq, 3 dumping operations (1982-1988); Kolguyev Island, 1.5 TBq, 1 dumping operation (1978); Chernaya Bay, 11 TBq, 1 dumping operation (1991); and Barents Sea, >4 TBq, 1 dumping operation (Date: ?).

7.1.2.2 Dumping Involving Spent Nuclear Fuel and Reactors

The Yablokov Reports states that between 1961 and 1981, 5 objects containing 7 reactors with spent nuclear fuel were dumped in the northern seas.

Only estimates are available for the total radioactivity (85100 TBq), and in only one case (the 'Lenin' shielding assembly containing fuel) is any breakdown of radionuclide content given. Mount et al [10] have also estimated the radionuclide inventory (approx. 63000 TBq-177000 TBq), but an accurate inventory would require release of documents by the Russian Navy.

The dumped reactors with fuel include:

-- In 1965 the reactor compartment of a nuclear submarine with two reactors, one of which contained spent fuel, was dumped in the Abrosimov Inlet (Novaya Zemlya) at a depth of 20 meters.

-- In 1965 a nuclear submarine compartment with two fuelled reactors was dumped in the Abrosimov Inlet, also at a depth of 20 meters.

-- In 1967 a shielding assembly from the 'Lenin' icebreaker containing 60% of the fuel, was dumped in the Tsivolka Inlet (Novaya Zemlya) at a depth of 49 meters.

-- In 1972, a reactor containing fuel from a nuclear submarine was dumped in the Novaya Zemlya depression (at 72-40N-58-10E) at a depth of 300 meters.

-- In 1981 a nuclear submarine with two fuelled reactors at Stepovoy Inlet (Novaya Zemlya) at a depth of 50 meters.

In addition, a total of 5 objects containing 10 reactors without spent fuel were also dumped in the Kara Sea. Only very approximate estimates were provided by Yablokov for these reactors (3700 TBq). These include:

-- The defuelled submarine reactor noted above, which was in the two-reactor compartment dumped in the Abrosimov Inlet in 1965, at a depth of 20 meters.

-- In 1965, a nuclear submarine reactor compartment containing two defuelled reactors was dumped in the Abrosimov Inlet at a depth of 20 meters.

-- In 1966, a nuclear submarine reactor compartment containing two defuelled reactors was dumped in the Abrosimov Inlet at a depth of 20 meters.

-- In 1967 the nuclear power plant from the icebreaker 'Lenin', comprising three defuelled reactors, with primary loop pipelines, was dumped in the Tsivolka Inlet at a depth of 50 meters.

-- In 1988, two defuelled reactors from a nuclear submarine were dumped in the Techeniye Inlet at a depth of 35-40 meters.

7.1.3 Dumping in the Far-Eastern Seas

For comparison it may be useful to consider the other dumping conducted by the former Soviet Union and Russia. According to the Yablokov report, 10 designated areas for dumping were identified in the far eastern seas, although only 1 of these meets the siting requirements set by the IAEA for the London Convention.

Liquid radioactive waste was dumped from 1966-1991, at five of these sites. By volume most of the liquid radioactive waste was discharged in Area 7 near the southeastern costs of the Kamchatka Peninsula, and by activity in Area 9 in the Sea of Japan.

Low and intermediate level solid waste dumping was conducted regularly in four of the designated areas from 1986. In terms of volume most of this was dumped in Area 9 in the Sea of Japan, and in terms of activity most was dumped in Area 8, of the southeastern coast of Kamchatka. The Yablokov Report states that 6868 containers of solid waste were dumped, along with 38 ships and 100 large objects.

Two defueled submarine reactors were dumped in the Sea of Japan in 1978, and one shield assembly without nuclear fuel from a nuclear submarine was dumped east of Kamchatka in 1989.

The activity dumped in the far-eastern seas is distributed as follows: liquid radioactive waste (456 TBq); intermediate and Low-level Solid Waste (225 TBq); and two reactors and 1 shield assembly (4,3 TBq). These figures do not include the 1993 dumping operation in the Sea of Japan (involving both liquid and possibly solid wastes).

7.2 Unintentional Dumping

The Soviet Navy has permanently lost during normal operations three nuclear-powered submarines and one diesel-powered ballistic missile submarine at sea due to accidents.

A Greenpeace report published in 1990 [11] based on western and Russian news accounts described these events in which 43 Soviet warheads and five Soviet reactors were lost at sea. In 1993 [12], Greenpeace published a new list updating its previous report based on new information gathered in Russia and from the Russian press, and obtained under the Freedom of Information Act in the United States.

The lost submarines are:

> -- A Golf class diesel-powered ballistic missile submarine which sank near Hawaii in March 1968, carrying three SS-N-5 missiles with one warhead each, and two nuclear torpedoes. Parts of the submarine were recovered by the Glomar Explorer in 1974 in a secret CIA operation.
>
> -- A November class attack submarine powered by two nuclear reactors and carrying two nuclear torpedoes sank in the Bay of Biscay in April 1970.
>
> -- A Yankee I class ballistic missile submarine powered by two nuclear reactors and carrying 16 SS-N-6 missiles with two warheads each, and probably two nuclear torpedoes sank off of Bermuda in October 1986.
>
> -- The Mike class submarine which sank off of Norway in April 1989. There was one nuclear-reactor and two nuclear torpedoes on the Mike.

The Yablokov report provided some estimation of the levels of activity in the lost submarines (in the case of the November and Yankee this was the first time such information has been made available):

-- The November submarine had an estimated maximum activity of about 9000 TBq in the reactors and 0.003 TBq activity in the nuclear warheads.

-- The Yankee submarine had an estimated maximum activity of about 9000 TBq in the reactors and 0.14 TBq activity in the nuclear warheads.

-- The Mike submarine had an estimated 5550 TBq in the reactor and 0.016 TBq in the nuclear warheads.

In the case of the sunken diesel-powered Golf ballistic missile submarine the Yablokov Report estimates that 1 kilocurie of radiation was contained in the warheads, and that when the bow was raised some 0.4 kilocuries of radiation were raised with it. It is unclear from the report which nuclear weapons were raised, but presumably this means one or two of the nuclear torpedoes on the submarine were recovered. It is doubtful the authors of the Yablokov report had reliable data on whether any nuclear weapons were recovered. Such information is in the hands of the CIA. It is to be hoped in the near future, the CIA can provide more details on how many of the nuclear-warheads, if any, were salvaged from the sunken submarine.

Elsewhere in the Yablokov Report, the loss of a 13000 TBq (350kCi) "RTG" radionuclide power supply lost during its transportation near Sakhalin Island is mentioned. (This reportedly was the power source for a nuclear-powered lighthouse, some 124 other nuclear-powered lighthouses are in the Far East.)

The Yablokov report also describes in detail a 1985 nuclear submarine accident in Chazhma Bay, which resulted in large-scale contamination on land, although the total release to marine environment is not provided. In 1992, however, contamination of bottom sediments by Co-60 in Chazhma Bay was estimated to be 0.185 TBq. By 1991, Co-60 contamination had been detected migrating outward from Chazhma Bay to Strelok Bay (which empties into the Sea of Japan).

Overall, however, the Yablokov Report states that no adequate information is available to describe unintentional losses such as reactors and warheads on sunken submarines; loss of warheads, reactors, and satellites, from plane crashes and failed launches; loss of radiation sources at sea; products of underwater and surface nuclear explosions.

Question 8: Could you estimate how much nuclear waste the Russian military complexes generate in a year?

The two main sources of Russian military nuclear waste are from: 1) the nuclear warhead production complex and 2) the operations of the 100 plus nuclear-powered submarines and four nuclear-powered surface ships in the Russian Navy.

The Yablokov Report provides some aggregate data on the amount of naval nuclear waste generated annually. The Yablokov Report states that each year the operation of Russia's nuclear submarines and nuclear-powered ships produces up to 20000 cubic meters of liquid radioactive waste and up to 6000 tonnes of solid radioactive waste. The Yablokov Report states that normal operations of the nuclear submarines requires transfer of about 10 cores in each fleet annually (i.e. just over 4000 fuel assemblies).

Figure 4 of the Yablokov Report lists the location of major radioactive waste sources and disposal areas in the northern seas.

As of yet, no official compendium of wastes generated by the Soviet/Russian nuclear weapons complex exists, although some information about the contamination at the production sites is contained in the response to Question 10 below. The committee should also consider directing this part of the question to U.S. government agencies for answers.

Question 9: Please describe the amounts and locations of nuclear materials deposited (intentionally and unintentionally) by the U.S. Government into the oceans, and any assessment of threats of these materials to human health.

9.1 Intentional U.S. Dumping

The United States dumped considerable quantities of radioactive wastes at sea from between 1946 and 1970, mainly in the Atlantic Ocean. In 1989, the United States officially reported to the IAEA the following dumpings [13]:

-- Atlantic Ocean Sites: between 1949 and 1967, dumping was conducted at 11 sites in the Atlantic Ocean. A total of 34,282 containers were declared to be dumped, although because of the uncertainty of early record-keeping that figure must be treated with caution. A total of 2.94x10.(E+6) GBq of radioactivity were dumped; and

-- Pacific Ocean Sites: between 1949 and 1970, dumping was conducted at 18 sites in the Pacific Ocean. A total of 56,261 barrels were declared to have been dumped, although the same concern expressed for the Atlantic sites applies here also. In all 5.54x10.(E+5) GBq of radioactivity were dumped.

The figures for the Atlantic Ocean dumping include the dumping of the USS Seawolf reactor shell. This was dumped in 1959, with an estimated radioactivity of 100,000 GBq, at a location about 120 miles off the Delaware-Maryland coast (at 38-30N, 76-06W).

9.2 Unintentional Dumpings

According to information collected by Greenpeace and published in 1990 [12], the United States has lost seven nuclear warheads or other nuclear weapons' material and two nuclear reactors at sea (in addition to the USS Seawolf reactor shell which was intentionally dumped).

Two submarines, each carrying one nuclear reactor, have sank -- one in 1963 and one in 1968:

-- The USS Thresher sank about 220 miles east of Cape Cod and 120 miles southeast of Cape Sable, Nova Scotia (at 41-45N, 65-00W), in the Atlantic Ocean in 1963.

-- In 1968 the USS Scorpion sank 400 miles southwest of the Azores, also in the Atlantic.

The seven warheads and other nuclear weapons materials were lost in a variety of circumstances: through air transit accidents, failed nuclear tests, accidental dropping, and through a submarine sinking.

-- In 1956 a U.S. Air Force B-47 bomber en route from Florida to Europe failed to make a rendezvous with its mid-air refuelling tanker over the Mediterranean Sea. No traces of crew or plane were found, and the location of the accident in the Mediterranean is unknown. On board were two capsules of nuclear weapons' material.

-- In 1962, two nuclear warheads mounted on Thor boosters were lost in the sea in separate incidents near Johnston atoll in the Pacific Ocean, after the weapons tests had to be aborted.

-- In 1965 a U.S. A-4E Skyhawk attack jet loaded with a B43 nuclear bomb fell off the USS Ticonderoga and sunk about 250 miles south of Kyushu Island, Japan and about 200 miles east of Okinawa (at 27-35.2N, 131-19.13E), in the Pacific.

-- The USS Scorpion was carrying two ASTOR nuclear torpedoes.

9.3 Health Effects

The United States' dumping (excluding unintentional losses) comprises around 7,5% of the total reported dumping (excluding that of the former USSR) in terms of radioactivity at the time of dumping.

Comprehensive quantitative risk assessments have not been performed for the radioactive materials dumped at sea by the United States. Indeed the only comprehensive dose assessment for radioactive waste dumping at sea has been conducted for wastes dumped at the North-East Atlantic dumpsite, latterly under the auspices of the NEA. It should be noted however that these risk quantitative risk assessments are subject to considerable uncertainty and are necessarily based on models which incorporate considerable simplifications.

A common assumption made in radiation protection which has received comparatively little study, is that if doses are kept below regulatory limits, then other organisms will be protected. It is far from clear whether this assumptions holds valid for dumping of radioactive wastes at sea, since the databases are very inadequate and it is questionable whether the existing models allow assessments to be made of the impact on non-human organisms.

The London Convention's IGPRAD (see reference [3]) was unable to define radiation doses below which no deleterious effects can be demonstrated in humans or other organisms, and therefore it must be assumed that all dumping has the potential to cause harm.

It should be noted that the above figures also exclude the radioactive materials entering the marine environment from surface or underwater nuclear weapons testing.

Question 10: Please characterize the threats of contamination to the Arctic Ocean from the following sources: storage facilities and holding ponds around the Mayak and Chelyabinsk-65 military complexes; other sources within the Ob river watershed; and decommissioned vessels harbored in bordering areas.

10.1 The Mayak and Chelyabinsk-65 military complexes

The most important facilities at Mayak have been six military production reactors, a radiochemical separation plant, a vitrification plant and waste storage facilities. Unfortunately information on this complex is still scarce, and a planned presentation on Mayak at the Kirkenes conference, mentioned earlier, did not take place.

Trapeznikov et al have reported on the contamination of the Ob river system from the Mayak enterprise [14]. They reported that because of liquid discharges of high-level radioactive waste from the Mayak complex in the late 1940s and 1950s, the Techa river contains enhanced levels of Sr-90, Cs-137, Pu-239, Pu-240, Am- 241, and Co-60. The levels of some radionuclides for long distances both upstream and downstream are orders of magnitude higher than would be expected from global fallout. In addition it has been reported that significant contamination of an area of many thousands of square kilometers has resulted from the waste storage tank accident in 1957 and from dispersal of heavily contaminated dust blown off Lake Karachay in 1967, although it is unclear to what extent this has contaminated the Ob river system.

In September 1951 discharges were eliminated by a system of canals and reservoirs which permitted the removal of significant radioactivity from the open drainage network. However, before this work could be completed, a large part of the flood plain and river sediments were contaminated and presently the Asanov swamps in the upper reaches of the river is an area of permanent contamination of the Techa. The Techa was withdrawn from economic use and several villages were evacuated.

Trapeznikov, et. al., reported their findings that more than 1 PBq of radionuclides from Mayak may be found further downstream in the Ob river system, and perhaps have entered the Arctic Ocean. It must be noted, however, that migration of radionuclides from the cascade of canals and reservoirs has been observed, and that this system contains most of the 4.3 PBq Sr-90 and 4.6 PBq of Cs-137 discharged from Mayak. Obviously a acute or even chronic failure of this system of canals and reservoirs could result in major releases to the Arctic Ocean. Moreover, continued operation of the Mayak facility creates the possibility for additional catastrophic accidents, which not only threaten the local population, but could also result in significant discharges through the Ob river system.

10.2 Other sources on the Ob Watershed

Additional contamination of the Ob system has occurred from the nuclear facilities at Semipalatinsk, Tomsk and the nuclear power plant near Ekaterinburg. Vakulovsky [15] reports some data for the discharges from the Tomsk site, but he provides no total quantities and does not discuss the contamination resulting from accidents. He does report, however, analyses in 1977 show Cr-51, Co-60, Mn-54 and Sc-46 in bottom sediments taken from the Tom estuary to the Ob estuary. More details are clearly needed for all of these facilities in order to assess the risks posed by them.

A significant source of long-lived radionuclides accumulated on the Ob catchment area is nuclear weapons testing fallout. Vakulovsky has estimated that the Ob catchment had accumulated some 7400 TBq of Cs-137 and 4.6 TBq Sr-90 by 1966, and he has estimated that nearly 650 TBq of Sr-90 from this source had flowed into the Kara Sea via the Ob river system between 1961- 1990 [15].

10.3 Decommissioned Vessels

In our view this should be seen as part of the wider naval nuclear waste problem. There is an acute lack of storage capacity for operational wastes as well as managing wastes arising from decommissioning, and the storage sites that do exist are reported to be in poor condition.

Estimates of the number of decommissioned or non-operational nuclear-powered submarines vary from some 100-140 vessels currently being out of service. Approximately, two-thirds of the decommissioned submarines are in the Arctic, one-third in the Pacific. At least another 20-30 vessels will be decommissioned by the end of the decade.

In the Arctic, decommissioned nuclear submarines are tied up in several fjords on the Kola peninsula near Murmansk, further east on the Kola peninsula at a submarine base at Gremikha, and at Severodvinsk on the White Sea.

In the Pacific they are located in the Shkotovo region east of Vladivostok at Bolshoi Kamen, Chazhma Bay, and Pavlovsk. Further up the coast decommissioned nuclear submarines are reportedly at Vladimir Bay near Olga, and are at Zavety Ilyicha between Vanino and Sovetskaya Gavan on the Tartar Strait. Non-operational submarines are also at the submarine base at Ribachiy near Petropavlovsk-Kamchatskii.

The few reactor compartments cut out of submarines are being stored afloat in Sayda-Guba on the Kola peninsula and in Razboynik Bay off of Chazhma Bay in the Shkotovo region in the Pacific. There may be other decommissioned submarines or reactor compartments in locations not yet discovered.

High-level waste storage sites for the Navy (two in the Arctic and two in the Pacific) are also full or reaching capacity. All are reported to be in poor condition. Other temporary land-based storage sites for lower-level waste are in similar condition. Service ships used to offload spent nuclear fuel and liquid and solid radioactive waste are also full and/or in poor condition.

The Yablokov report notes that spent fuel has only being removed from 15% of the decommissioned Naval submarines, and there is no possibility for removal of spent fuel from submarines with damaged cores. As of 1st January 1993 it was reported that the Northern Fleet was storing 3000 bundles of spent fuel assemblies, or 21000 fuel assemblies in total. It was reported that the Murmansk Shipping Company was also storing some 4500 spent fuel assemblies. The shore bases and ships of the Pacific Fleet were reported as storing some 8400 spent fuel assemblies, and spent fuel remains to be removed from 57% of the decommissioned submarines. Storage space remain, however, for only three more core-equivalents of fuel bundles.

The concentration of so much high-level nuclear waste near or on the shores of the Arctic and Pacific Oceans is a matter of some concern. Reportedly the Pacific Fleet storage sites alone contain some four million curies of radiation. This would include spent nuclear fuel located on land stored in cooling pools, ion-resin exchangers, and other low-level solid wastes. Accidents at these sites or involving the decommissioned nuclear submarines still containing their spent fuel could have substantial local environmental effects, and depending on the circumstances and location, international implications as well.

In this respect it should be noted that Chapter 22 of UNCED's Agenda 21 identified the threat to the marine environment associated with storage of radioactive wastes [4]. It stated, inter alia, that States should:

> not promote or allow the storage or disposal of high-level, intermediate-level and low-level radioactive wastes near the marine environment...

REFERENCES

[1] Facts and problems related to radioactive waste disposal in the seas adjacent to the territory of the Russian Federation, Materials for a report by the Governmental Commission on matters related to radioactive waste disposal at sea, established by Decree No.613 of the Russian Federation President, 24 October 1992.

[2] "Definition and Recommendations for the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter, 1972. 1986 Edition.", IAEA Safety Series No. 78, (1986).

[3] Final Report of the Inter-governmental Panel of Experts on Radioactive Waste Disposal at Sea, LC/IGPRAD 6/5, 31 August 1993.

[4] UNCED Agenda 21, Chapter 22.

[5] International Meeting on the Assessment of Actual and Potential Consequences of Dumping of Radioactive Waste into Arctic Seas, Oslo, Norway, February 1993.

[6] Arctic Research and Policy Act, as amended, Public Law 98-373, July 31, 1984, as amended by Public Law 101-609, November 16, 1990.

[7] See, for example, "Radioactive waste dumping in the Kara Sea: a critique of the joint Russian/Norwegian survey programme", paul Johnston and Ruth Stringer, Greenpeace Exeter Laboratory, University of Exeter, United Kingdom, Technical Note 06/92, October 1992.

[8] "Recovery, analysis and evaluation of radioactive waste packages retrieved from three former US ocean disposal sites", Robert Dyer, US EPA, paper presented to the International Meeting on the Assessment of Actual and Potential Consequences of Dumping of Radioactive Waste into Arctic Seas, Oslo, Norway, February 1993.

[9] "Possible roles of sea ice in the transport of hazardous materials", W.F. Weeks, Geophysical Institute, University of Alaska Fairbanks, paper presented to the Conference on Radioactivity and Environmental Security in the Oceans: new research and policy priorities in the Arctic and North Atlantic, Woods Hole, June 1993.

[10] Estimated Inventory of Radionuclides in Former Soviet Union Naval Reactors Dumped in the Kara Sea, Mark Mount, Michael Sheaffer, David Abbot, paper presented to the International Conference on Environmental Radioactivity in the Arctic and Antarctic, Kirkenes, August 1993.

[11] Naval Safety 1989: The Year of the Accident, Joshua Handler, Amy Wickenheiser, and William M. Arkin, Neptune Papers No. 4, Greenpeace, April 1990.

[12] Joshua Handler, "Trip Report: Greenpeace Visit to Moscow and Russian Far East July - November 1992 Subject: Russian Navy Nuclear Submarine Safety, Construction, Defense Conversion, Decommissioning, and Nuclear Waste Disposal Problems," (Greenpeace) 15 February 1993.

[13] Inventory of Radioactive Material Entering the Marine Environment: Sea Disposal of Radioactive Waste, IAEA TECDOC-588, March 1991.

[14] "Radioactive contamination of the Ob river system from the nuclear enterprise 'Majak' in the Urals", A. Trapeznikov, A. Aarkrog, N. Kulikov, S.P. Nielsen, V. Pozolotina, G. Polikarpov, V. Trapeznikova, M. Chebotina, V. Chukanov and P. Yushkov, paper presented to the International Conference on Environmental Radioactivity in the Arctic and Antarctic, Kirkenes, August 1993.

[15] "Transport of Artificial Radioactivity by the Ob to the Arctic Seas", V.M. Vakulovsky, SPA "Typhoon", paper presented to the International Conference on Environmental Radioactivity in the Arctic and Antarctic, Kirkenes, August 1993.

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To Cliff Curtis	From Morry Cone
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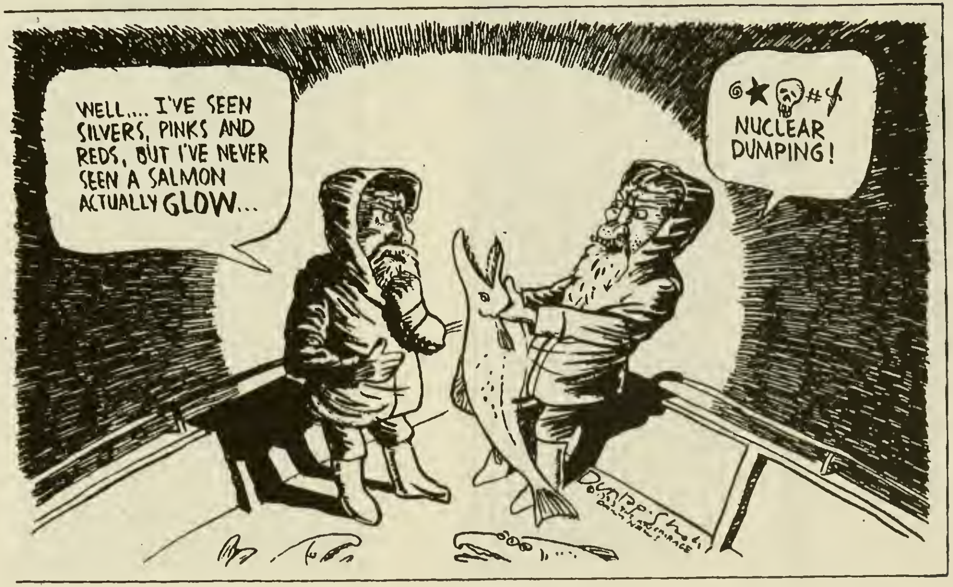
Anchorage Daily News Tuesday, November 30, 1993

OPINION


WELL.... I'VE SEEN SILVERS, PINKS AND REDS, BUT I'VE NEVER SEEN A SALMON ACTUALLY GLOW...
6★☠#✗ NUCLEAR DUMPING!
Dunlap-Shohl

THE NEW YORK TIMES **INTERNATIONAL** SUNDAY, DECEMBER 5, 1993

Russia Is Pressed on Nuclear Waste Accord

DAVID E. PITT
Special to The New York Times

UNITED NATIONS, Nov. 29 — Three weeks after 37 countries approved a legally binding ban on dumping low-level radioactive waste at sea, Russia is coming under increasing diplomatic pressure to pledge a permanent end to the practice, especially in the Arctic.

Although Britain, France, China and Belgium joined Russia in abstaining from voting on the ban and may decide to defy it, the effectiveness of the newly strengthened treaty — known as the London Convention — will hinge mainly on Russia's actions, diplomats and environmental experts agree.

There is concern that if Russia resumes dumping, as it has warned it may do, much of the material will end up in a disposal zone that the Russian military has been using for decades, off the archipelago of Novaya Zemlya in the Arctic Ocean. Many scientists view the Arctic ecosystem as particularly fragile, and suspect that the movement of pack ice may play a role in spreading radioactivity and other pollution over vast areas.

There is also concern that radioactive waste may be affecting the health of Eskimos and other indigenous people for whom fish and marine mammals like seals and whales are important food sources.

"It's a pretty dismal picture," said Scott Hajost, a former State Department negotiator who is international counsel for the Environmental Defense Fund. "But the clear hope is that the spotlight now being turned on the Russians will have some impact on the dumping question."

Under the rules of the London Convention, any of the 71 signatory countries has 100 days from Nov. 12 — the day the total ban on dumping radioactive waste was approved — to file a formal objection to any treaty change, in effect reserving the right to ignore the new prohibition on low-level waste dumping. Unlike most countries with radioactive waste disposal problems, Russia is not already constrained from dumping by a separate regional treaty.

The Arctic is the last major geographic area that lacks a regional environmental-protection agreement, and progress toward one has been slow.

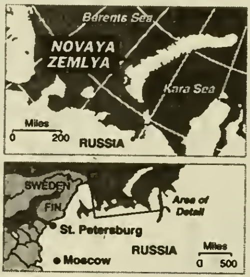
Russia's Environment Minister, Viktor Danilov-Danilyan, said this month that while his Government supports the idea of a total legal prohibition, it lacks the money and technical expertise to build enough land-based storage sites for its low-level wastes and will probably have to resume ocean dumping of those materials by 1995.

Some countries, especially the United States, assert that the Russians could abide by the dumping ban if they chose, but are trying to use concern over the marine environment to pry new assistance, especially hard currency, out of the West.

But other nations expressed willingness to examine Russia's case for new aid, particularly technical help in building storage sites, and called for an effort to try to distinguish what Russia wants from what it really needs.

In line with this, the London Convention signers — including the United States — agreed this month to form a team of experts to help Russia assess its waste-storage requirements, and called on Moscow "to provide appropriate access and support."

They also gave Russia until Feb. 1 to provide a description of its existing storage and treatment sites, and a full inventory of its low-level liquid waste — the vast bulk of it a byproduct of the reactors that power its submarines and icebreakers.



The New York Times

The seas off Novaya Zemlya may be threatened by atomic waste.

"PARTIAL TEXT OF THE REPORT OF THE LONDON CONVENTION MEETING, NOVEMBER 8-12, 1993"

The meeting:

- noted that the Russian Federation will not dump solid radioactive waste at sea and entirely supports the prohibition of dumping radioactive waste at sea;
- noted the Russian Statement regretting that inadequate treatment, conditioning and storage facilities create difficulties in discontinuing ocean disposal of liquid radioactive waste;
- noted the Russian Statement that adequate liquid radioactive waste facilities are planned to be built and operational in 1995 or possibly in 1994 if there is sufficient international support;
- called upon the Russian Federation to exert its best efforts to give a high priority to the early establishment of low-level liquid radioactive waste storage and treatment facilities;
- called upon interested States of the LC and in particular Japan, Norway, the United Kingdom and the United States as well as the Republic of Korea and the IAEA;
    - to form a technical advisory assistance team consisting of experts in radioactive waste management;
    - to explore the possibilities of international co-operation and assistance to the Russian Federation regarding the implementation of alternative land-based methods of radioactive waste disposal for the purpose of avoiding sea disposal of radioactive wastes;
    - to report, in co-operation with the Russian Federation, to LC 17;
- called upon the Russian Federation to receive and co-operate with the expert team and to provide appropriate access and support;
- called upon the Russian Federation to provide no later than 1 February 1994:

    (i) an inventory of the low-level liquid radioactive wastes, including amounts (volume, mass and activity), radio isotopic content, origin, location and nature of containment, for which present storage and treatment facilities are regarded as insufficient to relinquish the option of sea disposal;

(ii) an inventory of storage and treatment capabilities, including location and remaining unused capacity;

(iii) an inventory of the additional low-level liquid radioactive wastes and other material which are expected to be generated prior to 1 January 1996;

(iv) a statement of its plans for dealing with its storage and treatment needs both before and after 1 January 1996;

- called upon the Russian Federation to report to LC 17 on the progress made; and
- urged the Russian Federation to observe the ban on dumping prior to discussions in LC 17.

STATEMENT
OF
CORNELIUS W. SULLIVAN
DIRECTOR
OFFICE OF POLAR PROGRAMS
NATIONAL SCIENCE FOUNDATION

ON BEHALF OF THE
INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE (IARPC)

FOR THE

MERCHANT MARINE AND FISHERIES COMMITTEE
SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO
AND THE OUTER CONTINENTAL SHELF

U.S. HOUSE OF REPRESENTATIVES

Mr. Chairman and Members of the Committee:

I welcome the opportunity to present this statement on behalf of the Interagency Arctic Research Policy Committee, which is chaired by the National Science Foundation. Public Law 98-373, the Arctic Research and Policy Act of 1984 (ARPA), established the Interagency Arctic Research Policy Committee (IARPC) and authorized it to work with the Arctic Research Commission to develop a national Arctic research policy and a plan to implement that policy.

For more than a decade, there has been a growing recognition that the Arctic, rather than being a pristine, minimally inhabited environment, actually is an area where globally-generated contaminants and pollutants are concentrated.

Possible contaminants include radionuclides, persistent organic compounds, trace and heavy metals, and chronic hydrocarbon contaminants. Many of these contaminants are transported through the oceans, atmosphere, and biota. The present and potential impacts on human health, ecosystems, and our Nation's economic vitality from these contaminants are not known. To provide information for policy decisions with respect to the possible risks and Federal Agency responses to this contamination, the Interagency Arctic Research Policy Committee (IARPC) is preparing a focused, integrated research program under current budget constraints. This program will delineate an integrated, comprehensive assessment that includes data rescue and synthesis, observations, process oriented research, model development, impacts analysis and determination of risk, and information management.

Specifically, during the past two years, many international sources, including a Russian Federation Commission of Inquiry on "Questions Relating to the Dumping of Radioactive Waste at Sea," have independently reported and documented a history of dumping of nuclear waste and other toxic waste materials by the former Soviet Union into the Arctic Ocean, its marginal seas, and its larger fluvial tributaries; and into the northwestern-most Pacific Ocean. While these disclosures helped bring attention to the problems of Arctic pollution, radionuclides are just one aspect of Arctic contamination.

Other pollutants, including persistent organic compounds, and trace and heavy metals, may also pose serious threats to Arctic ecosystems and populations, including people. Besides direct discharge, contaminants are transported to the North through streams and rivers, ocean currents and atmospheric circulation. The levels of contamination and the risks posed by them are not well understood and require investigation. Anticipated increases in maritime transportation, industrial development, and exploitation of natural resources - possibly compounded by changes in the global climate - could further increase the threats to the sensitive Arctic ecosystem.

In response to this international awareness and concern the Interagency Arctic Research Policy Committee (IARPC) approved a Policy Statement on Arctic Contamination on August 27, 1992 and in November 1992, an Agenda for Action to implement the Policy Statement. (see attachment)

THE NEED FOR RESEARCH

The purpose of the IARPC research initiative is to establish an integrated, multi-agency Arctic Contamination Research Program, coordinated through the Interagency Arctic Research Policy Committee (IARPC).

IARPC Workshop on Arctic Contamination

From May 2-7, 1993, the IARPC conducted a Workshop on Arctic Contamination in Anchorage, Alaska. In addition to radionuclide contamination, the workshop addressed heavy and trace metal contamination, persistent organic chemical contamination, and chronic hydrocarbon contamination. The Workshop's purposes were to characterize the extent of Arctic contamination by evaluating and identifying existing data and information, to identify major data gaps, and to begin the process of determining whether specific Arctic contaminants present a risk to the environment, ecosystems, or human health in: a) Alaska, b) the entire Arctic, or c) the global environment.

The goal of the IARPC, and the ultimate purpose of the Workshop, was to provide U.S. Government decision-makers with a scientific basis for formulating US policy on Arctic contamination, specifically: 1) to acquire the information needed to understand the issue of Arctic contamination, and 2) to use this information for formulation of U.S. policy. These remain key objectives of the IARPC Arctic Contamination Research Program.

The Workshop indicated that a dearth of credible scientific information exists upon which to make conclusions and policy.

Significant Workshop results include findings that:

- Persistent organic compounds appear to be transported over long distances by air, water, ice, and organisms. These compounds are distributed throughout the Arctic, and many of them are accumulating to toxic levels as they move through the food chain. Generally, these compounds exhibit very slow degradation and thus remain in the system for extremely long periods.

- Excluding massive oil spills, such as that from the Exxon Valdez, little evidence exists that chronic hydrocarbon contamination affects Arctic food chains.

- High trace metal accumulations, many of which may be naturally occurring, are found at many sites in the non-U.S. Arctic. No information has been collected to indicate that critically high levels of trace metal contamination exist in Alaskan samples, but the possibility exists.

- The distribution of the different contaminants and the magnitude of the damage and risk resulting from the introduction of radionuclides, persistent organics, heavy and trace metals, hydrocarbons, and pesticides to aquatic ecosystems, terrestrial ecosystems, and human inhabitants of the Arctic and beyond is only minimally known.

- Forensic and other studies of marine species showed considerable variability in actual body burdens of contaminants for individual animals. Effects of contaminants on species at the individual and population level are not understood at the present.

- Little systematic information exists about FSU radionuclide dump sites or the integrity of dumped materials. Although many sites have existed for more than 25 years, most contaminant dump sites are uninvestigated.

- Little is known about the distribution, accumulation rates, or the impact of other Arctic contaminants on Alaska, the Arctic, or the global environment.

The Arctic: A U.S. and International Resource

The Arctic is a unique, sensitive, and vulnerable environment, which, when damaged, is extremely slow to recover. The Arctic is defined by the Arctic Research and Policy Act to include "all United States and foreign territory north of the Arctic Circle and all United States territory north and west of the boundary formed by the Porcupine, Yukon, and Kuskokwim Rivers; all contiguous seas, including the Arctic Ocean and the Beaufort, Bering, Chukchi Seas; and the Aleutian chain."

Our recognition of the value of the Arctic has matured dramatically in recent years. We now appreciate more fully its economic and strategic significance to our nation. More than 50% of the U.S. continental shelf and coastline lies within Alaska, with much of it in the Arctic.

The interaction of the Arctic with the remainder of the world raises additional concerns. Contaminants can be imported and exported by unique ice transport processes, by the movement of air and water masses, by migrating wildlife and by economic activity such as the commercial transportation of Arctic fishery resources to lower latitude markets.

The Arctic shelves contain some of the richest commercial fisheries in the world and large populations of birds and marine mammals. Contaminant accumulation in the food chain may have a direct impact on the global human population. As an example, the U.S. pollack fishery in the Gulf of Alaska and Bering Sea is estimated to be a $2 billion industry, yet there is insufficient information about contaminants in the Bering Sea ecosystem for long-range planning to assure that this fishery and others will remain viable.

Increased resource development and use of the Arctic for transportation presents additional risks to the Arctic environment. A better understanding of Arctic systems, including biological, atmospheric, oceanic, ice and sediment transport dynamics, and rates of recovery of damaged ecosystems is needed.

Contamination and the Arctic Environment

The Arctic contamination issue is far more complicated than just discharge of contaminants from the Former Soviet Union. Resource development, mining, and petroleum production have been long term sources for the introduction of contaminants into the Arctic. Persistent organic compounds from North America, Asia, and Europe, coal combustion products from Europe and Asia, and other types of contaminants with a global origin all appear to be accumulating in the Arctic. Detectable quantities of radioactivity from nuclear plants at Sellafield, United Kingdom and Cap La Hague, France are found entering the Barents Sea from the west. Historical and ongoing introduction of contaminants also exists within the U.S. Arctic. In Alaska alone, more than 150 sites were identified by the Defense Environmental Restoration Program to require some level of environmental cleanup. In addition, current fuel storage and distribution practices make hydrocarbon contamination a significant issue in most rural Alaskan communities.

The Yablokov Commission Report identifies that the FSU dumped (in violation of international law) or lost in the marine environment, radionuclide materials totaling more than 2,500,000 curies of radioactivity. Most of this was lost or dumped in the Arctic. This quantity of dumped materials represents twice as much material as has been disposed into the Atlantic and Pacific Oceans by all the other nations on Earth combined. Included in this total are large volumes of liquid radioactive waste, sealed barrels of solid radioactive waste, fueled nuclear submarines, and more than one dozen intact nuclear reactors. Solid fuel wastes, totaling another 10,000,000 curies of radioactivity, are presently stored in Murmansk harbor awaiting development of depository sites.

Other reports indicate that radioactive and toxic waste products are stored in temporary impoundments, or have been dumped into lakes and rivers including the Ob, Lena, and Yenisey Rivers, which are tributaries to the Arctic Ocean. One example, Lake Karachi, a small lake in the southern Urals, may have received more than 100 million curies of plutonium waste.

Recently the Russian Federation identified radioactive waste dump sites in the northwesternmost Pacific Ocean. NSF has no information about the impact of these wastes on the adjacent Bering Sea.

Nuclear reactor accidents (Chernobyl in 1984, Myak in 1957, and Tomsk in 1993) and a multi-year history of atmospheric, surface, and subsurface nuclear weapons testing (especially in the Novaya Zemlya region) have produced radioactive atmospheric fallout over much of the Arctic. The presence of other nuclear reactors throughout the Russian Federation and eastern Europe, similar in design to those of Chernobyl, poses a continuing threat to the Arctic, the State of Alaska, and indeed to the entire nation.

Linkages

1. International - The IARPC Arctic Contamination Research Program is primarily focused on contaminant risk to U.S. lands, waters, and people. Results of the U.S. Program would be shared with the Arctic Environmental Protection Strategy (AEPS), a signed, although legally nonbinding, international declaration established by the eight Arctic nations (Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden, and the U.S.) to protect the Arctic. Results will be coordinated with AEPS' Arctic Monitoring and Assessment Program (AMAP), a cooperative program established in 1991 by the eight Arctic nations to assist in monitoring and assessing the Arctic environment. The primary objective of AMAP is to measure levels of anthropogenic pollutants and to assess the effects of pollutants on the Arctic environment.

2. National - All the United States' Arctic land is located within Alaska. The risk from contaminants to Alaskan lands, waters, and people is a concern of vital importance to the State of Alaska. The State has many, on-going relevant programs within its Departments of Environmental Conservation, Natural Resources, and Health and Social Services. The IARPC Arctic Contamination Research Program will coordinate with State of Alaska programs to maximize utilization of available resources and to share research results.

The indigenous people of Alaska have a lifestyle heavily augmented by subsistence hunting activities. They have the highest risk of potential impact from Arctic contamination. The participation of Alaskan Natives in contaminant research is a goal of the IARPC. The Native Regional Corporations and the Alaska Federation of Natives will serve as fora for Native involvement in the IARPC Arctic Contamination Research Program.

CONCLUDING REMARKS

The National Science Foundation supports the approach of a coordinated interagency assessment of the potential contamination of the Arctic by chemical and other contaminants, including radionuclides. We are anxious to work with the Congress in developing such a program through the

Interagency Arctic Research Policy Committee, under current budget limitations.

The success of a U.S. program is contingent on information exchange and cooperation. We must critically evaluate historic and current data to understand the risks and to provide a foundation for making recommendations about future research and monitoring activities. Communication of results and research needs among U.S. researchers, decision makers, the public, Arctic inhabitants, and between the U.S. and the international community is essential.

INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE
POLICY STATEMENT ON ARCTIC CONTAMINATION

(adopted August 27, 1992)

The U.S. and other countries are becoming aware of a potential problem that requires international cooperation: the extent of contamination of the Arctic area and the bordering seas by radioactive materials and a variety of other hazardous substances.

For example, there are many reported instances of Former Soviet Union disposal of radioactive and other toxic wastes directly into the Arctic Ocean and into aquatic and terrestrial Arctic and Subarctic sites. The contamination reported in the Former Soviet Union is of concern to eight Arctic nations and other countries because of the potential for redistribution and:

1) the level and distribution of radioactive and toxic contamination in terrestrial, aquatic, and marine Arctic environments,
2) the ecological risk of surface contamination to terrestrial, aquatic, and marine Arctic ecosystems,
3) the health risk to human populations, and
4) the economic impacts associated with contaminant transport throughout the Arctic and adjacent seas, and affecting fisheries, foodstuffs and other resources.

At present there is limited information regarding such contamination. Scientifically based quantitative data are essential for sound risk assessment activities.

IARPC agencies support a coordinated U. S. program to evaluate the ecological and health risks of Arctic contamination and a coordinated international effort under the umbrella of appropriate international organizations to:

1) evaluate the scope of this problem,
2) rescue data from world archives, and
3) promote international scientific cooperation.

The international organizations include, for example, the Arctic Environmental Protection Strategy, with its focused efforts under the Arctic Monitoring and Assessment Program (AMAP), the International Atomic Energy Agency (IAEA), the International Maritime Organization (IMO), and the International Arctic Science Committee (IASC).

INTERAGENCY ARCTIC RESEARCH POLICY COMMITTEE
AGENDA FOR ACTION
to Implement
POLICY STATEMENT ON ARCTIC CONTAMINATION

(approved November 25, 1992)

IARPC intends to pursue an incremental plan to implement the Policy Statement on Arctic Contamination (adopted on August 27, 1992). IARPC will implement appropriate steps as warranted by successive analyses and available funds. These steps are:

1) Identify, compile and evaluate existing data on Arctic contamination resulting from the practices of the Former Soviet Union, in cooperation with scientists in other countries. Include results of 1992 *Polar Star* and Office of Naval Research cruises.
2) Assess the rates of movement of toxic materials and contaminated organisms into and out of Russian territorial waters. Assess the probable long-term effect on food webs and peoples of the North, and through export of fishery products, on peoples of lower latitudes. Where warranted, define the additional data necessary to assess the scope of the problem.
3) Depending on the outcome of the assessment activities, define policy issues, additional risk assessment activities, and risk management options for mitigative actions or other steps commensurate with the scientific risk or exposure assessments.
4) Define the potential for advancing Arctic science by measurements of labeled isotopes.

International collaboration will be conducted through the International Arctic Environmental Protection Strategy and its focused efforts under the Arctic Monitoring and Assessment Program (AMAP), and through bilateral cooperation and agreements with Russia. Data and information will be broadly shared.

The actions endorsed at this time are:

I. IARPC will sponsor one or more workshops to evaluate and assess the compilation of existing data and analyses and to recommend future actions toward an integrated assessment of Arctic contamination.
II. IARPC, working through the U.S. Coast Guard and the U.S. Geological Survey, will design a series of monitoring activities to be conducted on the 1993 cruise of the *Polar Star*. These experiments will expand the compilation of biological, hydrological, and geological baselines in the western Arctic Basin and Margin, begun on the 1992 cruise of *Polar Star*.
III. Depending on the results of I and the availability of funds, IARPC agencies will issue an interagency announcement to solicit proposals from the scientific community to implement the recommendations from I.
IV. IARPC directs its Arctic Environmental Monitoring and Assessment Task Force to plan and implement these activities and to coordinate IARPC's actions with the International Arctic Environmental Protection Strategy and its focused efforts under the Arctic Monitoring and Assessment Program (AMAP).
V. IARPC will integrate specific research and assessment plans of U.S. Federal agencies into the Third Biennial Revision to the U.S. Arctic Research Plan that will be submitted to the President by July 31, 1993.

Interests and Concerns of the State of Alaska Regarding Radiological Contamination in the Arctic Ocean

Testimony by Mead Treadwell,
Deputy Commissioner,
Department of Environmental Conservation,
State of Alaska
before the
Subcommittee on Oceanography, Gulf of Mexico,
and the Outer Continental Shelf

September 28, 1993

INTRODUCTION

Mr. Chairman, and members of the sub-committee, my name is Mead Treadwell. I am deputy commissioner of Alaska's Department of Environmental Conservation. I am submitting written, rather than oral, testimony, as I am in Tromso, Norway, attending a meeting of the Northern Forum, an association of Governors and regional leaders from the North, including Japan, Canada, Russia, United States and Scandinavia.

The subject of your hearing is of much concern to all of the regional leaders present and especially our Governor, Walter J. Hickel. Through the Northern Forum, Alaska and other regional governments have been working together to encourage greater disclosure of dumping practices by the former Soviet Union, investigation and monitoring of the effects of dumping, and cessation of dumping as soon as practical. The Northern Forum is an observer to the Arctic Environmental Protection Strategy.

Through the Forum, we have also been working to expand knowledge about Russia's nuclear power plants which threaten northern citizens with airborne emissions. I recently led a team of U.S. and state experts in emergency prevention and response to the Bilibino Nuclear Power Plant, located on the Chukotka Peninsula and the potential source of Russian radiation that is perhaps closest to American soil. This visit, which included experts in emergency response from the Nuclear Regulatory Commission and the Environmental Protection Agency, was funded in part by the Office of Naval Research. The State Department and the Environmental Protection Agency are funding a "rapid assessment" of environmental problems in the Russian Far East by the State of Alaska, working in conjunction with Northern Forum counterpart governors and environmental protection agencies in Chukotka, Magadan, the Sakha Republic (Yakutia), Kamchatka, Khabarovsk, Primorski, and possibly the Jewish Autonomous Region. This effort will identify other sources of contamination known to regional authorities.

Since the end of the Cold War, we have all heard reports which describe in great detail the real and potential radiological problems within the former Soviet Union -- nuclear power plants in varying states of disrepair, radioactive waste dumping into the Pacific and the Arctic Ocean, and contamination resulting from decades of nuclear testing and accidents. At its closest point, Alaska is less than two miles from the former Soviet Union. We are downstream from airborne and waterborne sources of radionucleides that could affect the health of our citizens, the wholesomeness of our food and drinking water, and the overall integrity of our environment.

At the same time the end of the Cold War has brought forward concern about threats to Alaska from Arctic contamination, this time has also brought cooperation, and potential for greater cooperation, between Arctic neighbors than any of us have seen in our lifetime. We are proud of the fact that the people of Alaska have taken a major role in building relationships and institutions of cooperation with our Russian neighbors. Through these institutions, we're seeing the beginning of a tradition of not only a free market economy but the free exchange of ideas and knowledge. When we approach Russia to talk about safety, protection of the environment, or preparation for common emergencies, we are sometimes involving Russia's local governments, concerned citizens, and indigenous peoples in open discussion of these issues for the first time. Thus, we are building more than bridges to protect health or save lives -- we are helping to build the traditions of interaction, openness, and constructive debate upon which a true democracy depends.

In this broad context, we come to the issue of radiological contamination in the Arctic Ocean. As reports of dumping and unsafe nuclear practices have come to light in recent years, the State of Alaska has developed a number of policy goals in response. Summarized briefly, they are:

1. Find out what is there.

2. Establish continuous monitoring to provide an early warning of traveling radiation.

3. Develop ties with Russia for more direct communication in the event of a nuclear accident, and for information sharing in the event of transport in the water column and the food chain.

4. Make sure the United States and Alaska are prepared to deal with problems which

might arise. This includes risk communication with our residents.

5. Focus additional international efforts on prevention, including support for a ban on dumping nuclear waste in the Arctic Ocean.

Mr. Chairman, these goals have developed as our knowledge of the problems have developed. At the same time we have looked across the Bering Sea, we have looked at our own house -- and have worked to put it in order. Toward that end, at the Governor's request, our State Emergency Response Commission completed a preliminary review of radiological threats facing Alaska earlier this year. We have worked with the U.S. Department of Energy this summer to remove a mound in which radioactive soil was deposited near Point Hope by the U.S. Geological Survey, in the early 1960's. We have been working with the Department of Defense to contain and remove radioactive soil at Ft. Greely from a shutdown nuclear reactor, and we are working with the Department of Energy to monitor the nuclear test site at Amchitka Island in the Aleutians. With the U.S. Navy, we have reviewed contingency plans for a nuclear submarine accident as subs approach the Back Island testing facility near Ketchikan. With the Department of Defense and the Nuclear Regulatory Commission, we have reviewed safety concerns with the use of RTG's, radioisotope thermal electric generators, at several sites in Alaska including the Bering Strait. And with the oil industry, we have seen improved management practices for NORM, Naturally Occurring Radioactive Material, that is a by-product of oil exploration and production. As a matter of risk, however, we must address external threats to Alaskans from radiation as well as internal threats.

In Congressional testimony last year, Glenn Shaw of the University of Alaska Fairbanks Geophysical Institute showed that it was only by a fluke in wind patterns that fallout from the Chernobyl accident missed Alaska. A major release from any of the more than twenty nuclear power plant installations located in the former Soviet Union would threaten Alaskans and other Arctic residents because of moving air masses, and in winter, especially, the tendency of the Arctic air mass to form a closed circulation pattern. Inspections of Soviet-built nuclear power generation facilities by members of the international scientific community have raised serious questions regarding the safety of the designs of many of the existing plants and the ability to safely maintain and operate them, given the current social and economic crisis in the area. Notification provisions, were an accident to happen again, are weak -- inside Russia and out. Our visit last month to the Bilibino Nuclear Power Plant showed no absence of expertise -- just a lack of resources, with four areas of major deficiency -- fire safety, monitoring equipment, communication equipment, and waste disposal of most concern to both the hosts and the visitors.

Waterborne threats from radiation and other contaminants are of concern because they may be harder to detect -- and it is more difficult to pin down a source. We are happy the Russians have, with the publication of the Yablakov report this spring, been forthright about what they know. Alaska's concerns -- and U.S. concerns -- are based on the fact that a major part of our food supply and our economy derives from fisheries stocks in the Bering Sea which might be affected by releases in both the Pacific and the Arctic Oceans. Our native peoples especially depend on species which can concentrate contaminants brought to them by the food chain.

Mr. Chairman, with that introduction, I would like to convey several recommendations by the State of Alaska to you and your colleagues today.

Issues and Recommended Actions

1. **International Cooperation.** The U.S. can not rely on scientific work or diplomacy alone to rectify these problems. People to people communication at many levels will raise concern to help change Russian practices from within. We support a thorough and comprehensive effort by the United States (including the State of Alaska), working with the national **and regional** governments of the Russian Federation to identify and communicate sources of radiation or other toxins **either in the Arctic Ocean or likely to reach the Arctic Ocean.** Land-borne sources of radionucleides carried by runoff potentially become waterborne sources. We further support and advocate further international cooperation in efforts to prevent contaminated soils from entering the water. The activities of identification have just begun.

2. **Monitoring.** In a cooperative effort with the U.S. Environmental Protection Agency (EPA), Alaska has reactivated a statewide radiation monitoring network, the Environmental Radiation Ambient Monitoring System (ERAMS), consisting of sampling sites in Anchorage, Fairbanks and Juneau. We are also working with the Department of Energy to establish a network of Pressurized Ion Chambers (PIC) on the Alaska coast to supplement the existing ERAMS equipment operated by the state, EPA and the University of Alaska.

This early warning system for airborne contamination needs to be replicated for waterborne contamination. We believe it is important for the U.S. to fund a "musselwatch" type approach to further monitor toxins in the North Pacific, the Bering Sea and the Arctic Ocean, based in the U.S. and Russia. This idea was discussed at a meeting on Arctic contaminants held in Anchorage this past May under the sponsorship of the Interagency Arctic Research Policy Committee. NOAA has an active "musselwatch" program elsewhere in the United States -- and we would like to invite its extension to our part of the world. Alternatively, the ongoing International Atomic Energy Agency (IAEA) monitoring effort for the North Atlantic, White and Kara Seas could be extended for the North Pacific, Bering and Chukchi Seas. To our knowledge, there has been little study at all of radionucleides in the North Pacific, even after reports of Russian dumping in the Sea of Japan and the Sea of Okhotsk.

For both airborne and waterborne sources, it would be optimal to have a continuous monitoring system established, on American and Russian soil, with notification procedures to make us aware of any radioactive material that is migrating. The studies that have been conducted so far should help us establish that network. Facilities at the State of Alaska and the University of Alaska would be willing to cooperate in this work.

Notification and Drills. We support the efforts of the Nuclear Regulatory Commission under the Lisbon Initiative to establish a communications network for emergency response from nuclear power plants where there is potential for airborne releases or spills in water. This system would provide an important communications link for during a response for notifying potentially affected communities.

During our visit to Bilibino, we learned there is no regular, daily communication between the plant and any central authority, as there is in the United States. The network which is being established by the NRC in cooperation with its Russian counterpart deserves additional resources so that it can be expanded to all operating nuclear facilities, on land on water (nuclear powered icebreakers are used in the Arctic). We plan to test these notification procedures through cooperation of the IAEA, the Arctic Environmental Protection Strategy, and the Northern Forum as a follow-up to our Bilibino visit, sometime in 1994.

4. **Research.** Our concerns about radiation in the Arctic need to be backed by a full U.S. commitment to Arctic contaminants research. Unfortunately, just as U.S. interest in protecting the Arctic environment is growing, the Environmental Protection Agency has decided to "disinvest," one year from now, in its work on Arctic contamination. This decision was made without consulting the State of Alaska or the U.S. Arctic Research Commission, and threatens to undercut altogether the U.S. commitment to the Arctic Monitoring and Assessment Program (AMAP.) We also believe it is important for the United States to address the needs identified by AMAP and fund not only our fair share but work to make sure our aid recipient, the Russian Federation, fully participates as well.

The Environmental Protection Agency's endangered Arctic Contaminants Research Program, based in the Office of Research and Development, costs just about $1 a response for notifying potentially affected communities.

During our visit to Bilibino, we learned there is no regular, daily communication between the plant and any central authority, as there is in the United States. The network which is being established by the NRC in cooperation with its Russian counterpart deserves additional resources so that it can be expanded to all operating nuclear facilities, on land on water (nuclear powered icebreakers are used in the Arctic). We plan to test these notification procedures through cooperation of the IAEA, the Arctic Environmental Protection Strategy, and the Northern Forum as a follow-up to our Bilibino visit, sometime in 1994.

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The Environmental Protection Agency's endangered Arctic Contaminants Research Program, based in the Office of Research and Development, costs just about $1 million per year, and it is helping to develop the most complete set of evidence we will have to address sources of contamination which affects the Arctic from outside the Arctic. Ministers of the Arctic Environmental Protection Strategy meeting in Nuuk, Greenland last week indicated their desire and intent to take the case of pollution transported into the Arctic to the family of contributing nations for redress -- but they can't do so without evidence.

Mr. Chairman, if this hearing has no other result, it would be a success if the U.S. restores that funding for that program.

5. **Risk Communication.** Arctic contamination is a problem that not only needs monitoring and notification, but an active effort to explain what we know to the residents of the Arctic. We are in support of the U.S. Arctic Research Commission and others working with the National Science Foundation to fund a program to better exchange results of scientific research in the Arctic with indigenous peoples of the North. We believe, given our own experience with the mound of soil that was removed from the Project Chariot site near Pt. Hope that continuous communication with all levels of government and with the citizenry directly is vital.

6. **Economic and Technical Assistance.** On our trip to Bilibino, we found that our environmental and safety concerns were rooted in economic concerns. At the meeting of environmental ministers the week before last in Greenland, the U.S. and other nations pressed Russia to stop dumping altogether. We were told Russia didn't have the means to stop. Until that means is found, Russia is not bearing the true cost

of nuclear energy. Russia has the expertise -- we need to make sure we are giving them the help to raise the resources to solve these problems. That does not necessarily mean sending money -- it means sharing the ethic that nuclear safety now pays later.

7. **Cease Dumping in the Oceans.** Finally, we hope this subcommittee will follow closely the U.S. position at the upcoming meetings of the London Dumping Convention and push to develop a plan so that Russia stops dumping nuclear waste in the Arctic and the Pacific as soon as possible. Russia and seven other Arctic nations agreed in Nuuk, Greenland, this month to work toward a total ban on dumping nuclear waste in the Arctic Ocean. An international commitment to provide technical and economic assistance to Russia may be necessary before this can be accomplished.

Mr. Chairman, the United States may itself wish to keep its options open on ocean dumping of low-level nuclear waste. If that is the case, then the time is now to set and enforce minimum standards under international law.

Thank you very much for the opportunity to testify today. We will be providing the committee with a copy of our trip report to Bilibino as soon as it is published.

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AND THE OUTER CONTINENTAL SHELF
OF THE COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES

on

"RADIOACTIVE CONTAMINATION IN THE ARCTIC REGION AND THREATS TO THE MARINE ENVIRONMENT AND HUMAN HEALTH"

SEPTEMBER 30, 1993

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INTRODUCTION

The Environmental Defense Fund (EDF) is a leading national environmental organization with over 200,000 members which links science, economics and law to create innovative, economically viable solutions to today's environmental problems. EDF has launched an initiative to address Arctic environmental issues, including an assessment of the multi-media pollution threats to the Arctic and an evaluation of the effectiveness of the existing legal regime to provide sufficient protection to the Arctic, including its marine environment.

Recent scientific research and studies have led to both an increased awareness of the importance of the Arctic ecosystem to global atmospheric and oceanographic systems, as well as its relative fragility. As western scientists have been allowed greater access and freedom to investigate the state of the Russian Arctic environment, evidence of large-scale environmental degradation from multiple sources has surfaced to paint a picture of unregulated nuclear weapons and energy production, and massive oil, gas and mineral exploitation activities conducted without provision for adequate environmental protection measures. Radioactive fallout from the Chernobyl incident contaminated portions of the Arctic terrestrial and marine environment. Acid rain, nitrogen oxides, lead, PCBs and DDT have also appeared in the Arctic, but the precise air, water and sea ice transport pathways remain uncertain. Levels of heavy metals and persistent organochlorines in some whales and polar bears are disturbingly high.

Due to the high lipid content of many Arctic fauna, particularly marine mammals, some pollutants enter the food chain, remain for long periods of time and accumulate at higher concentrations at the top of the food chain. The Arctic is home to a diverse group of indigenous peoples who rely on Arctic species as a food sources. Some reports indicate that contamination of the food supply may ultimately affect human health.

In 1991 the eight Arctic rim States (Canada, Denmark - Greenland, Finland, Iceland, Norway, Russia, Sweden and the U.S.) adopted a "Declaration on the Protection of the Arctic Environment," and the Arctic Environmental Protection Strategy (the AEPS). Under the AEPS, working groups have been established to develop and implement programs for the assessment and monitoring of contaminants in the Arctic environment, the conservation of arctic flora and fauna, improved coordination in responding to ecological emergencies occurring in the Arctic and the protection of the marine environment. Radionuclides were identified in the AEPS specifically as a contaminant source and given a high priority in terms of monitoring and assessment activities. Earlier this month, the Arctic rim States met in Nuuk, Greenland, at the Second Ministerial Conference on the Arctic Environment to evaluate progress under the

AEPS and reaffirm their countries' commitments to environmental protection in the Arctic, including promoting the goals of the Rio Earth Summit.

THE ARCTIC MARINE ENVIRONMENT

The Arctic Ocean and its marginal seas; the Barents, Bering, Beaufort, Chukchi, East Siberian, Kara, Laptev, Norwegian, Greenland and White seas, and northern Canadian waters, are readily identifiable as a geographically cohesive and ecologically sensitive region. The Norwegian-Greenland Sea area acts as one of the world's largest "CO2 sinks" and is the site of North Atlantic deepwater formation which contributes to the structure of the global ocean and northern hemisphere climate. The Barents and Bering Seas are two of the world's most productive fishing grounds, with the Bering Sea alone accounting for 10% of the world's fish catch.

The Arctic marine environment is faced with significant threats from a wide variety of anthropogenic sources, including global warming, ozone depletion, nuclear reactors and other wastes dumped in the shallow waters near Novaya Zemyla, long-range sources of airborne pollutants, land-based run off, operational vessel discharges, and oil and gas production activities. There are currently 60-80 Russian Federation Navy nuclear submarines in Arctic harbors awaiting decommissioning and disposal, a number which is predicted to reach 150 by the year 2000. The effects of these present and potential stresses range from immediate harm to humans (as indicated by Russian health studies) and Arctic flora and fauna, to long term damage to entire ecosystems and includes the possibility of disrupting important global climate and oceanic mechanisms. In addition, cold temperatures, the extensive presence of sea ice, and an absence of sunlight during the winter months all contribute to the vulnerability of the Arctic to environmental stresses.

SEA ICE: A UNIQUELY ARCTIC TRANSPORT MECHANISM

Growing concern over Arctic pollution has led to interest in the transport of contaminants by the atmosphere and ocean. However, drifting sea ice may also play a role. The potential for sea ice to redistribute contaminants -- a little known transport mechanism -- could turn out to be important in understanding the unique Arctic environment. Much of the ice within the central Arctic ice cover is formed initially on the marginal seas, and in particular, the wide Siberian shelf seas such as the Kara and Laptev Seas. Sea ice formation may incorporate contaminants found in the water column, airborne fallout, as well as from sediments in shallow waters, including possibly radionuclides. As sea ice floes are transported thousands of kilometers over several years through the Arctic region, these accumulated contaminants may be released into the sea surface when the ice thaws, re-freezes and thaws again far from the original source of pollution. Russian scientists have said that annual sea ice formation "cleans" their marginal seas of pollutants.

Unfortunately, most melting and therefore particle/pollutant release occurs in the marginal ice zone, where there is also the highest degree of biological activity in Arctic surface waters. Here fauna associated with the ice form an important link in the food chain between primary producers and fish, sea birds and mammals. If ice fauna are contaminated by pollutants carried by sea ice, these pollutants will be passed upwards through the food chain, including ultimately to humans. The significance of the biological uptake and retention of pollutants greatly in excess of ambient levels by aquatic animals is that concentrations in living tissues may increase, posing greater danger to both the organisms themselves, as well as to animals that feed on them (either predators on live animals or scavengers on dead ones). This uptake and accumulation are referred to collectively as bioaccumulation. Bioaccumulation of organochlorines and heavy metals may result in concentrations in the Arctic food chain that could adversely affect marine, terrestrial and human health.

Another process unique to the polar regions that may affect materials dumped into shallow Arctic seas, is the gouging of the sea floor by sea ice pressure ridges and icebergs. Sea ice pressure ridges on the Siberian shelves often have a draft of 25 meters, and have been documented in the Eurasian Arctic extending down to 43 meters. Recent iceberg gouging in the Barents Sea has reached depths down to 120 to 130 meters, but is generally less than 100 meters, and may penetrate more than 5 meters into the sea floor with a width between 10 to 50 meters. Given the shallow depths of the majority of Russian radioactive waste dumpsites, there is a very real danger that such gouging may damage or destroy whatever containment systems remain, and release contaminants directly into the water column.

RUSSIAN RADIOACTIVE CONTAMINATION IN THE ARCTIC

Ocean Dumping

President Gorbachev's 1987 Murmansk speech began to lay the foundation for enhanced bilateral and multilateral Arctic scientific cooperation related to environmental assessment and protection. As Russian scientists have been allowed greater access to the West and freedom to disclose the state of the Russian Arctic, evidence of large-scale environmental degradation from multiple contaminants has surfaced to paint a portrait with frightening implications. Improperly disposed nuclear materials in Russian Arctic waters is a concern that has drawn considerable international attention. The pressures of the Cold War arms race and scarce or non-existing financial resources dedicated research into safe land disposal methods combined to produce an unprecedented record of improper disposal of radioactive waste into the Arctic marine environment.

The 1992 report prepared by a senior level government commission headed by A. V. Yablokov, Adviser to the President of the Russian Federation for Matters of Ecology and Public Health, documented past Soviet practices and continued Russian federation problems with nuclear waste [hereinafter the Yablokov Report]. The Yablokov Report confirmed that since 1959 over 7000 containers of liquid and solid radioactive waste, 154 "large unenclosed objects," including twelve submarine nuclear reactors, three icebreaker reactors, and 17 vessels contaminated by radiation had been dumped in the Barents and Kara Seas off the coasts of Novaya Zemlya. The majority of the solid materials appear to have been dumped into waters less than 50 meters deep, and in certain instances items were dumped into waters with a depth of only 12 meters. Although the dumping of solid radioactive waste into the marine environment appears to have been halted, the Russian Navy continues to dispose of liquid radioactive waste into the Arctic marine environment.

Despite the fact that the Yablokov Report is the most forthcoming description of radioactive waste dumping in the Russian Arctic, the Report itself admits that there are significant gaps that require immediate attention. In particular, it states that there has been no direct monitoring of radiation conditions in the vicinity of the solid radioactive waste disposal sites for the past 25 years. There exists no precise data on the level of nuclear activity associated with many of the dumped items, including spent nuclear fuel and reactor components. The Report notes that the containment barriers used for solid and liquid wastes were not tested under field conditions for resistance to corrosion, which brings into question their short and long term structural integrity. Finally, the Report revealed that in some instances containers of solid radioactive waste were shot in order to accelerate their sinking, which would release at least some of the contents into the marine environment.

The Yablokov Report acknowledges that many of these dumping actions were made in contravention of: 1) ban on ocean disposal of high level radioactive waste established under the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter (London Convention); 2) the London Convention's moratorium on ocean dumping of intermediate and low-level radioactive wastes; 3) International Atomic Energy Agency (IAEA) guidelines for ocean disposal of such materials; and 4) domestic regulations promulgated in 1987. While the moratorium is not legally binding, it clearly reflects the majority global view that radioactive waste should not be disposed at sea, and Russia is the only country known to have ignored its terms. Article IV of the

London Convention bans the disposal at sea of all substances listed in Annex I, which includes:

> High-level radioactive wastes or other high-level radioactive matter, defined on public health, biological or other grounds, by the competent international body in this field, at present the International Atomic Energy Agency (IAEA), as unsuitable for dumping at sea.

Article IV(1)(b) of the London Convention requires Contracting Parties to issue a prior special permit to dump substances listed under Annex II, which states:

> Radioactive wastes or other radioactive matter not included in Annex I. In the issue of permits for the dumping of this matter, the Contracting Parties should take full account of the recommendations of the competent international body in the field, at present the IAEA.

Article VI(4) provides that all disposal activities carried out under Annex II must be reported to the Convention's Secretariat at the International Maritime Organization.

In particular, the IAEA Recommendations provide:

> (1) Dumping shall be restricted to those areas of the oceans between latitudes 50 N and 50 S. The area shall have an average water depth greater than 4000 meters. . . .

and;

> (2) Sites should be located clear of continental margins and open sea islands, and not in marginal or inland seas. . . .

The first recommendation categorically excludes the entire Arctic marine region from all radioactive disposal activities. The exclusion is based on the presence of active vertical ocean circulation patterns found in the polar areas, which could potentially transport wastes away from the dumpsites. Even absent the Arctic limitations, the remaining provisions would serve to limit ocean disposal options in the Arctic to the central Arctic basin. Again, the Yablokov report indicates that radioactive waste has been dumped into coastal waters with depths less than 50 meters. Such areas are excluded as dumping sites because they pose the highest risk for potential contamination of both marine and coastal ecosystems. Both the London Convention and the IAEA Recommendations contain extensive reporting requirements which appear to have been completely ignored by the Former Soviet Union, and it is unclear to what extent the Russian Federation is reporting on continued dumping.

At the Tokyo Summit, the G-7 leaders noted the reports on Russian dumping activities in the Arctic, and stated:

> In light of existing international obligations, we emphasize our concern over the ocean dumping of radioactive wastes by Russia.

The Arctic rim countries addressed this topic at the recent Nuuk Ministerial Conference, and agreed to:

> ensure that no disposal of radioactive waste or material will be made in Arctic waters in violation of provisions of the London Convention (1972). They will work and cooperate to provide, in the nearest possible future, a ban on all dumping of radioactive waste in Arctic waters, taking into account the revision of the London Convention.

The U.S. has opposed a regional ban, citing the need for maintaining all options for disposal of nuclear wastes, as well claiming a preference for dealing with the issue at the global level under the London Convention. U.S. law prohibits the dumping of high-level radioactive wastes under the Ocean Dumping Ban Act of 1988 (33 U.S.C. Sec. 1412(a)), and the disposal of low-level radioactive wastes would require a permit issued by the Environmental Protection Agency (EPA) and approval by a joint resolution of Congress (33 U.S.C Sec. 1414(i)). The U.S. has not disposed of radioactive wastes at sea since 1970, and never in the Arctic, and it seems unlikely that it will attempt to resume the practice in the near future.

Also, the U.S. has previously entered into a binding regional marine environmental agreement which prohibits the disposal of any radioactive materials at sea in the South Pacific region, the Convention for the Protection of the Natural Resources and the Environment of the South Pacific Region (SPREP Convention), which entered into force for the U.S. in 1991. Article 10 states:

> The Parties agree to prohibit the dumping of radioactive wastes or other radioactive matter in the Convention Area.

The SPREP Convention represents a precedent for U.S. participation in a regional ban. This approach is consistent with the London Convention Article VIII, which states:

> In order to further the objectives of this Convention, the

> Contracting Parties with common interests to protect in the marine environment in a given geographical area shall endeavor, taking into account characteristic regional features, to enter into regional agreements consistent with the objectives with this Convention . . .

The U.S. should acknowledge the release of the Yablokov Report as a first step, and call upon the Russian Federation to report on its current activities and provide access to existing documents and information. Given the express proviso of the IAEA Recommendations on the unsuitability of the Arctic for ocean disposal of any such wastes, the U.S. should support such a ban regardless of discussion on a global ban. The U.S. should also support a global ban at the London Convention meeting in November.

Land Based Sources of Radiological Contamination

Russian rivers contribute the largest volume of fresh water into Arctic waters and are a significant source of land-based forms of pollution. The Pechora, Ob, Yenisey, Southern Lena and Kolyma Rivers have high concentrations of contaminants. In particular, the Chelyabinsk nuclear weapons production facility is reported to have discharged radioactive wastes directly into the Techa River in the past, contaminating it for thousands of kilometers. There is also the possibility that radionuclides from mining or weapons production activities, or wastes improperly disposed on land, may leech into these rivers and be transported to the Arctic Ocean. As Siberian rivers freeze during the fall they incorporate particles and bottom sediment, including rocks weighing up to 30 kilograms, into the ice. Spring break-up of river ice is a violent event whereby ice dams form, and then are destroyed, rapidly discharging large volumes of water. River beds are gouged by tumbling ice and eroded by torrential water flow. Polluted sediments, contaminants and waste containers on the river bed may be dislocated by these events and transported downstream into the Arctic marine environment. In addition, sediment deposits resting at the mouths of Siberian rivers may be flushed out into the marginal seas by "hundred year" flood events.

The July 1993 meeting in Arkhangelsk, Russia, of the Advisory Committee on the Protection of the Sea (ACOPS) focused on "Pollution of the Coasts of the CIS with Special Emphasis on the Arctic." The participants at this conference noted the importance of protecting the Arctic marine environment from land based sources of radioactive contamination and concluded that:

> The storing and disposal of nuclear and other hazardous wastes in Russia's Arctic areas necessitated various precautionary actions including the completion of an inventory of such sites to establish their number, size, location and evaluation thereof to assess their condition, the risks involved, and whether the sites need to be decommissioned or, if not, the measures required to stabilize them. The existing legal and administrative arrangements for ensuring good maintenance or decommissioning of these sites should be similarity identified and evaluated; in particular whether sound environmental engineering practices had been instituted for closure of such sites and whether guidelines for such procedures should be developed.

ACOPS also called for a meeting of international experts on legal and policy mechanisms for protecting the Arctic marine environment from land based sources of marine pollution. The Arctic Ocean is the only remaining marine region that is not protected by a specific legally binding regional agreement. Agenda 21 Chapter 17, "Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources," identifies land based sources of marine pollution as contributing 70% of contaminants entering the marine environment, including sewage, nutrients, synthetic organic compounds, litter and plastics, metals, radionuclides, and oil/hydrocarbons and other polycyclic aromatic hydrocarbons. Chapter 17.24 calls a upon states to take action on this issue at the regional level. The U.S. and other Arctic rim countries should support the development of a legally binding comprehensive Arctic agreement addressing marine environmental protection, including all land based sources. At the Nuuk Conference the ministers charged the Marine Environment working group with the task of assessing the need for further instruments to prevent the pollution of the Arctic marine environment, and additionally agreed to consider the development of regional instruments concerned with the protection of the Arctic environment.

Radiological Accidents in the Russian Arctic

In 1985 the crew on a Russian nuclear submarine refueling in Chazma Bay violated safety procedures causing an uncontrolled spontaneous uranium fission chain reaction in the port reactor. The ensuing thermonuclear explosion destroyed a portion of the submarine and released a 5 1/2 kilometer wide radioactive plume with fallout that extended 30 kilometers from the site. According to the Yablokov Report, radioactive contamination was generally limited to local impacts, but steps must be taken to ensure that systematic monitoring of the area is maintained. A Russian nuclear submarine, the Komsomolets, lies at the bottom of the Norwegian Sea near Bear Island as a result of an accidental fire at sea. Although several expeditions to the Komsomolets have revealed that little contamination has entered the local marine environment, the Yablokov Report expresses concern over future releases of plutonium 239 from the submarine's nuclear warheads. More research is required on this subject before an accurate risk assessment can be made.

Accidental airborne releases of radionuclides are also a source of contamination in the Arctic environment. The first major nuclear accident in the Former Soviet Union occurred in 1957 at the Chelyabinsk nuclear weapons plant when a waste storage tank exploded and contaminated over 23,000 square kilometers. Today Lake Karachay contains up to 120 million curies of radioactive waste, enough so that one hour of exposure from the shore can be fatal, and reports indicate that materials are leaking into groundwater sources. This site merits highest priority in terms of both assessment and remediation efforts. In addition to radionuclides released by approximately 100 documented above ground nuclear tests conducted at Novaya Zemlya, the cloud of radioactive materials produced by the Chernobyl disaster drifted into the Arctic. There are four Chernobyl-type reactors still operating in the Arctic region today.

These examples document conditions of concern regarding radioactive contamination in Russia. At the 1992 Munich Economic Summit the G-7 leaders expressed their concern over the safety of Soviet-designed nuclear power plants, and offered support for an action program dedicated to:

- operational safety improvements;
- near-term technical improvements to plants based on safety assessments;
- enhancing regulatory regimes;

and an assessment for the need to:

- replace less safe plants by the development of alternative energy sources and the more efficient use of energy;
- upgrading plants of more recent design.

In July 1993 the G-7 leaders once again called for urgent action on Russian nuclear safety in their Tokyo Summit Economic Declaration, and included a recommendation for the early closure of the highest risk reactors.
As described in the Nuuk Ministerial Conference Report, the ministers of the Arctic rim state took the following actions to address these issues within the framework of the Arctic Environmental Protection Strategy (AEPS).

> The ministers agreed to:
>
> ensure that nuclear installations that may affect the Arctic meet international nuclear and radiological safety standards established by the IAEA;
>
> initiate action to prevent further increase in activity levels of anthropogenically derived radionuclides, irrespective of sources, and to reduce such levels, in order to keep the contamination as low as reasonable achievable;
>
> initiate clean-up programs for selected areas, where needed.

EMERGENCY NOTIFICATION PROCEDURES

The Emergency Prevention, Preparedness and Response (EPPR) working group has compiled a list of contact points and developed a reporting system to handle notification of pollution emergencies with potential transboundary impacts, and an assistance network to respond to such events. In the Nuuk Declaration on Environment and Development in the Arctic the ministers stated:

> We underline the importance of prior and timely notification and consultation regarding activities that may have significant adverse transboundary environmental effects, including preparedness for natural disasters and other emergencies that are likely to produce sudden harmful effects on the Arctic environment or its peoples.

The ministers called upon the EPPR working group to:

- support completion by the end of 1994 of an inventory and qualitative risk assessment for facilities or activities that may pose risk of significant accidental pollution;

- review relevant international agreements and guidelines to ensure that they provide sufficient protection for the Arctic;

- promote mutual assistance programs between Arctic for both assessment and response activities.

This effort should extend to nuclear contamination emergencies.

All eight Arctic rim countries have signed, but not all have ratified the 1986 IAEA conventions; the Convention on Early Notification of a Nuclear Accident (the Early Notification Convention), and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (the Assistance Convention), which was developed in response to the Chernobyl accident.

The goal of the Early Notification Convention is to minimize the transboundary consequences of a nuclear accident by providing relevant information to potentially affected parties as quickly as possible. Article 1(2) of the Early Notification Convention describes the scope of activities and facilities covered by its provisions:

> (a) any nuclear reactor wherever located;
> (b) any nuclear fuel cycle facility;
> (c) any radioactive waste management facility;
> (d) the transport and storage of nuclear fuels or radioactive wastes;
> (e) the manufacture, use, storage, disposal and transport of radioisotopes for agricultural, industrial, medical and related scientific and research purposes; and
> (f) the use of radioisotopes for power generation in space objects.

Although by its terms the Convention does not apply to military facilities or vessels, at the time of signing the Convention all five nuclear powers, including the Former Soviet Union and the United States, stated that they would voluntarily comply with its provisions in the event of a military nuclear accident. Articles 2 and 5 describe the coordinating role of the IAEA and detailed reporting requirements.

The goal of the Assistance Convention is "to facilitate prompt assistance in the event of a nuclear accident or radiological emergency, to minimize its consequences and to protect life, property and the environment from the effects of radioactive releases." Articles 2, 3 and 4 establish the emergency assistance decision-making process including guidelines for information exchanges, the transfer of available response equipment, and identification of emergency contact points. The IAEA is called upon to play a central coordinating role, and to develop substantive guidelines for response procedures.

Both Article 9 of the early Notification Convention and Article 1(2) of the Assistance Convention anticipate bilateral and multilateral agreements which take regional considerations into account. As of 1990 there were several bilateral agreements on Early Notification of a Nuclear Accident between Arctic rim states, including Norway/Sweden, Norway/Finland, Norway/USSR, Sweden/Denmark, Finland/USSR, Finland/Sweden, Finland/Denmark, and Sweden/USSR, but none involving the U.S., and no agreements related specifically to mutual assistance.

At the 1992 Senate Select Committee on Intelligence field hearing on "Radioactive and other environmental threats to the United States and the Arctic resulting from past Soviet activities," CIA Director Gates made reference to U.S. efforts to assist the Russian Federation in extinguishing oil well fires in the Uzbekistan region. The U.S. and other Arctic rim countries should explore opportunities with the Russian Federation to establish response teams in the field of nuclear accidents.

LIABILITY FOR NUCLEAR ACCIDENTS WITH TRANSBOUNDARY CONSEQUENCES

Principle 13 of the Rio Declaration addresses domestic and international liability and compensation issues and calls upon states to:

> cooperate in an expeditious and more determined manner to develop further international law regarding liability and compensation for the adverse effects of environmental damage caused by activities within their jurisdiction or control to areas beyond their jurisdiction.

Of the Arctic rim states, only Denmark, Norway and Sweden have ratified the Convention on Third Party Liability in the Field of Nuclear Energy (Paris Convention), and the Vienna Convention on Civil Liability for Nuclear Damage (Vienna Convention). These agreements discuss rules of liability in the of damage caused by nuclear accidents. They establish the principle that operators of nuclear installations will be liable for damage caused to personal or private property by an accidental release of radiological contamination, and set minimum and maximum liability amounts for domestic legislation implementing the treaties. Sweden is the sole Arctic party to the Convention Relating to Civil Liability in the Field of Maritime Carriage of Nuclear Material. This Convention establishes liability rules for damage caused by nuclear accidents occurring in the course of maritime carriage of nuclear material, and imposes liability on the vessel's operator.

The U.S. and Arctic rim countries should assess the application of these Conventions to the Arctic, and consider the need for any specific Arctic arrangement in the absence of an agreed acceptable global regime.

ASSESSING CURRENT RISK LEVELS

In response to the revelations concerning radioactive waste disposed of in the Russian Arctic, a series of international scientific conferences has been held to assess the risks involved and to develop response strategies. At this point in time there exists no consensus as to the precise degree of risk due to insufficient information and data. However, the scale of reported dumping is unprecedented as is the corresponding lack of monitoring efforts. It is clear that comprehensive monitoring programs must be carried out immediately in order to provide the necessary information for accurate quantitative and qualitative assessments. The following are areas of concern that should be addressed in this process, as well as what describing what information is still needed:

1) an inventory of civil and military wastes in the Arctic;
2) documentation of storage methods/conditions (including dumped materials);
3) environmental monitoring for each site;
4) international coordination of regional monitoring of radionuclides in marine, freshwater and terrestrial ecosystems;
5) containment or remediation measures required for heavily contaminated areas;
6) transport pathways, sinks and biological uptake processes in the Arctic.

Given the number of uncertainties, a precautionary approach should be applied to any decision-making process involving risk assessment, containment and remediation issues. Rio Declaration Principle 15 defines a precautionary approach as; "Where there are serious threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

The U.S. should also participate in joint monitoring and assessment programs in the Russian Arctic marine environment, and assist in the cataloging of waste disposal sites in the vicinity of Novaya Zemlya.

The IAEA, supported by the U.S. and other Arctic rim countries, has already responded to the situation and in February 1993 launched the International Arctic Seas Assessment Project (IASAP). This program seeks to:

> 1) assess risks to human health and to the environment associated with the radioactive waste dumped in the Kara and Barents Seas;
>
> 2) examine possible remedial actions related to the dumped wastes and to advise on whether they are necessary and justified.

To the extent possible, the U.S. should continue to support the work the IASAP, and ensure that studies produced are incorporated into the on-going work of AMAP.

The University of Texas's "GERG" program has just completed field work under an ONR grant in the Russian Arctic that included retrieving sediment, water and tissue samples from the Ob and Yenisey Rivers, as well as the coastal region of the Kara Sea. This program is an example which may serve as a model for future expeditions whereby U.S. scientists utilize Russian vessels to conduct their field work. It is important to note the disappointing outcome of the U.S./Russian cruise aboard the Mendeleev, which was denied access to the monitoring areas by the Russian Ministry of Defense this past summer. Despite efforts on the part of the State Department and several U.S. Senators, the Russians were unwilling to allow U.S. scientists into the Novaya Zemlya marine dumpsites for even limited sampling. The U.S. could create incentives for greater cooperation in this area by linking existing and forthcoming financial aid to Russia to access to contaminated sites for monitoring and assessment purposes.

In Nuuk the ministers also charged the Arctic Monitoring and Assessment Program (AMAP):

> to perform a long term assessment of potential releases to the environment of radioactive materials (e.g. from nuclear installations, waste disposal sites and contaminated regions), and to improve risk prediction capabilities.

A subgroup has been established within AMAP to facilitate the radiological assessment process and to forge working relationships with the IAEA, the Coordinated Research and Environmental Surveillance Program of OECD/NEA (CRESP), the North Atlantic Cooperation Council (NACC), NATO's Committee of Challenge of Modern Society (CCMS), and relevant regional organizations such as the Barents Euro-Arctic Council. The International Arctic Science Committee (IASC) should also be included in this process. Within the U.S., the Interagency Arctic Research Policy Committee (IARPC) and the Arctic Research Commission (ARC) should play a stronger role in addressing Arctic contamination issues, including radioactivity.

These activities should also be coordinated with AMAP, the Marine Environment and Conservation of Arctic Flora and Fauna working group programs to ensure that their particular areas of emphasis are given due consideration throughout the assessment process. The current ad hoc nature of the working groups makes such coordination difficult, and highlights the need for an Arctic secretariat dedicated to the role as facilitator.

FINANCIAL MECHANISMS

The magnitude of the radiological waste and disposal problems revealed in the Russian Arctic will require significant financial commitment on the part of the U.S. and other Arctic rim states to effectively address these issues. The U.S. is currently providing $417 million over the next four years in assistance to Russia under the 1992 Freedom for Russia Support Act. This package includes $32 million ear-marked for environmental initiatives, but no funding is directed toward programs dedicated to Arctic contamination. To the extent possible, a portion of this existing aid package should be applied to support prompt joint U.S./Russian monitoring and assessment expeditions to the Kara Sea radioactive waste dump sites. The House and Senate have approved a broader foreign aid bill which includes approximately $12 billion designated for Russia. A portion of these funds should be linked to long-term monitoring and assessment actions as well as remediation efforts (proper decommissioning of nuclear subs/disposal of waste). For example, the Russian Federation has indicated that it will continue to dispose of liquid radioactive wastes into its coastal seas due to the unavailability of land storage and disposal options. The U.S. and other Arctic rim countries should take steps to initiate cooperative measures designed to assist Russia in providing capacity for safe land disposal of all such wastes, including transfer of available technology as well as engineering and technical support as appropriate.

President Clinton has continued to express his support for providing aid to Russia, as announced following his meeting President Yeltsin at the Vancouver Summit in April 1993. At Vancouver, President Clinton also reaffirmed U.S. commitments to expanded environmental cooperation and nuclear reactor safety initiatives. Beyond U.S. bilateral aid, the Arctic rim states should continue to pursue multilateral funding sources, including the World Bank, the Nordic Investment Bank, the European Bank for Reconstruction and Development, and the European Investment Bank. This approach has been utilized in the Baltic Sea Joint Comprehensive Program, which is charged with implementing the clean-up and protection strategies identified under the revised Baltic Sea Convention. The parallels between the two situations, transboundary impacts, fisheries, large catchment basins and insufficient domestic financial resources, suggest that a successful campaign to address Russian Arctic environmental problems will require a combination of bilateral and multilateral funding sources. As appropriate, the U.S. should also identify private investment opportunities for American corporations in restoration, energy efficiency, nuclear safety and other activities supporting environmental protection.

INDIGENOUS PEOPLES

At the Rio Earth Summit in June 1992, the status of indigenous people around the world was placed in the context of environmental protection and development issues. Both Principle 22 of the Rio Declaration and Agenda 21, Chapter 26, refer specifically to the importance of incorporating indigenous people into the decision-making process related to environmental and development issues. The AEPS recognizes the important role of Arctic indigenous peoples, and supports their involvement in Arctic environmental protection initiatives. At Nuuk, the ministers of the Arctic rim countries reaffirmed their commitment to indigenous peoples issues and announced the formation of a task force on sustainable development with a mandate in part to ensure that indigenous knowledge is effectively incorporated into the AEPS process. They should be engaged in discussions and actions related to radioactive contamination in the Arctic.

CONCLUSION

The U.S. last articulated its Arctic policy in 1983 at the height of the cold war. There is an ongoing effort by the present Administration to develop a new policy in which protection of the Arctic environment and its inhabitants will move to the forefront. It is important that this process be concluded in the near future in order for the U.S. to play a leadership role in protecting the fragile Arctic environment, including from radioactive pollution.

As part of this new policy, the U.S. should ensure that its aid to Russia is fully coordinated with its Arctic activities. Moreover, provision should be made for an integrated and focused U.S. Arctic research and monitoring effort so as to address major problems and actively participate in AMAP. This will require adequate budgetary resources for EPA and NOAA and there should be an overall assessment of mandates and responsibilities of IARPC and ARC as well as the goals and purposes of the 1984 Arctic Research and Policy Act to bring it up to date with the many changes in the world since its enactment.

In particular, the U.S. should support not only an Arctic ban, but also a global ban on radioactive waste disposal at sea and work with other concerned countries in assisting Russia to implement such a ban. Finally, the U.S. should lend strong support to development of a comprehensive Arctic environment and development treaty, including marine waters, which would provide a permanent legal and institutional framework to promote Arctic protection efforts.

ATTACHMENT 1

Rural Alaska
Community Action Program, Inc.

September 7, 1993

The Honorable Don Young
United States House of Representatives
Washington, D.C. 20515

Dear Don Young:

Our organization has recently learned some disturbing facts about the federal commitment to dealing with the Arctic regions within our nation in a coordinated and committed fashion. We participate in a collaborative effort among non-governmental groups which have an interest in the areas of indigenous people and environmental concerns. This effort is known as the US Arctic Network and is supported at this time by a grant to the Alaska Conservation Foundation from the U.S. State Department.

The most urgent and primary concern is that the Environmental Protection Agency has in its FY 95 budget eliminated any efforts to monitor the Arctic environment of our country. There was only a small effort within the agency looking at the known disposition of contaminates in our Arctic regions that are generated in Asia and Europe and which are transported across the pole by various atmospheric and oceanic conditions. The staff who have been instrumental in providing technical assistance in the development of the international Arctic Monitoring and Assessment Programme's working paper has had their support removed and can no longer participate even in the planning and drafting of Arctic monitoring efforts.

We are also concerned about the continual lack of coordination between federal agencies for programs which deal with our country's Arctic regions. The Arctic Research Policy Act is now ten years old. The Arctic Research Commission meets regularly and the Interagency Arctic Research Policy Committee is in place and yet in the past month neither group was aware that the National Parks Service has begun a monitoring program, which included work in Alaska this past summer, and will include work in the U.S. Arctic in the near future, to assess the environmental status of the Parks. Why this effort to monitor the ecosystems was not know to the bodies which are in place to coordinate all research in the Arctic is unclear and unacceptable. Likewise, individuals within the Public Health Service have been named as primary contacts for monitoring the environmental impacts on human health in the Arctic who have no knowledge that they were being listed nor do they have specific programs in that area. This becomes embarrassing to everyone involved.

Administration • P.O. Box 200908, Anchorage, Alaska 99520 • (907) 279-2511, FAX (907) 279-6343

The end of the cold war has brought a growing interest in the polar regions due to the realization that they hold many natural resources. There has also been a growing scientific interest in the Arctic as it is the most likely area of the globe to show early indications of general significant warming and the resulting environmental impact on communities of our country; increased ultraviolet - B radiation due to ozone depletion; increased body burdens of radioactive materials, persistent organic compounds including organochlorines, and heavy metals; and the associated human health impacts of all of these conditions.

We are requesting that you investigate why, at such a critical time for additional information and long-term monitoring that, the EPA is withdrawing its funding. We request that you investigate why, after ten years of the Arctic Research Policy Act, there is not better coordination and cooperation between federal agencies. We request that you promote and keep in focus that there are thousands of citizens of this country who live in the Arctic and who depend closely on the natural resources of the polar region to maintain their health. We request that you investigate the number of potential threats to environmental and human health that are impacting a significant portion of our nation. We request that you investigate and support research to learn about the international contamination of roughly ten percent of the land mass of our nation, its Arctic environment in Alaska.

Thank you for your consideration and action on these requests. We would be glad to provide additional information if you would be interested in learning more of the details of our concerns. Thank you.

Sincerely;

Jeanine Kennedy
Executive Director

cc: Tucker Scully, Director of Ocean Affairs
Albert Gore, Jr.-Office of the Vice-President
Raymond Arnaudo - Chief, Div. of Polar Affairs
Carol Browner, Administrator, EPA
Alvin L. Ewing, Alaska Regional Director
Donald D. O'Dowd, Chairman, Arctic Research Comm.
Bruce F. Molnia, Chairman, Technical Committee
Walter E. Massey, Chairman, National Science Foundation
The Honorable Frank H. Murkowski
The Honorable Ted Stevens

ATTACHMENT 2

ARCTIC RESEARCH COMMISSION

RESOLUTION

The ARCTIC RESEARCH COMMISSION convened on August 11, 1992 in Nome, Alaska;

Recognizing that the United States is an arctic nation with arctic territory, residents, resources and responsibilities,

Concerned by a number of public accounts of significant environmental pollution dumped by the Former Soviet Union onto the tundra and directly into Arctic seas and rivers that flow into the Arctic Ocean caused by:

1) Use of nuclear weapons detonations for civil excavations,

2) Nuclear wastes from chemical production facilities dumped or draining into rivers,

3) Disposal of nuclear ship reactors and radioactive wastes from nuclear power plants in the Kara Sea,

4) Large quantities of mixed industrial wastes dumped in rivers, land fills and vented to the atmosphere, and

5) Large numbers of deaths and illness attributed to radiation accidents and over-exposures to radioactive materials;

Conscious of the International agreements to dismantle and dispose of many nuclear weapons;

Noting the hearing in Fairbanks, Alaska of the Senate Select Committee on Intelligence on August 15, 1992 on this subject;

Finding that there is substantial need to:

1) Determine the degree of risk to circumpolar nations, resources and people, and

2) Examine the opportunity to measure arctic processes labeled by isotopes.

Having determined by direct discussions with the Commission on Arctic Research of the Russian Academy of Sciences that Russian scientists are interested and able to join assessment efforts to establish the factual dimensions of the pollution problem and risks to arctic nations and people, and that international mechanisms are already in place for collaboration;

Hereby urge the Interagency Arctic Research Policy Committee in conjunction with U.S. arctic expertise to proceed to prepare and coordinate a multi-agency scientific plan designed and supported to:

1) Compile and validate existing data on this issue.

2) Define and obtain additional data necessary to assess the scope of the problem.

3) Assess the rates of movement of toxic materials and contaminated organisms beyond Russian territorial waters and the probable long-term effect on food webs and people of the North.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
INTERNATIONAL ACTIVITIES

July 7, 1993

Dr. Hugh Livingston
Chairman, Conference Planning Committee
Radioactivity and Environmental Security in the Oceans
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543

Dear Hugh,

On the last day, June 10th, of the recent Conference on Radioactivity and Environmental Security in the Oceans, a formal press briefing was held by Woods Hole Oceanographic Institution (WHOI) on behalf of the Conference. At the start of the briefing, a prepared statement (attached) was distributed and read aloud. The press statement was subsequently revised by WHOI (attached). We are concerned that both versions of the WHOI press statement, in particular the first sentence of the first paragraph (which remains the same in both versions), are premature and too sweeping in their connotations. Consequently, we are concerned that the WHOI press releases lend themselves to misinterpretation at a time when critical information is about to be collected concerning past disposals in the Kara Sea.

The lead sentence of the press statements, which seems to represent a capsule summary of the conference, reads:

> "There is a *strong consensus* among conference participants that there is *no evidence* of any regional scale radioactive contamination in the Arctic and North Atlantic Oceans that currently poses a threat to *human health* or *causes environmental concern.*" [italics added for purposes of this discussion]

We have four specific concerns with this summary sentence; they are:

(1) the process by which the reported "strong consensus" was obtained,

(2) the use and implications of the terminology, "no evidence,"

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(3) the professional expertise of the conference attendees as a whole supporting formal announcements on issues regarding radiation effects on "human health", and

(4) the departure of the statement in substance and tone from the conclusions of the two other scientific conferences held so far in 1993 (Oslo, Norway and Anchorage, Alaska), that also addressed issues of Arctic radioactive contamination and worked with essentially the same scientific information.

The WHOI conference is the third international scientific conference to be held this year on the subject of Arctic contamination; the first in Oslo, Norway, in February and the second in Anchorage in May. The lack of certain essential data and the uncertainty about the conditions of sources, release rates, fate and effects in the Arctic marine environment (particularly the Kara and Barents Seas) was a recurring theme in all three. In particular, it was acknowledged at these meetings that the available data, even on certain aspects of the source terms, was sparse to nonexistent and that neither systematic environmental monitoring and surveys, nor human health risk assessments have been conducted for these regions by verifiable third party national or international collaborative efforts. This situation was stressed in regard to those locations in the Kara Sea where nuclear reactors and damaged reactor fuel have been dumped.

The tone of the WHOI press statements suggest conclusions based on a strong body of evidence, but the definitive, evidentiary information that would support such a statement had not been marshalled and presented at the WHOI conference nor previously at the other two referenced international conferences. **Lack of evidence [or information] should not be equated with "no evidence."**

In regard to the available information, the Yablokov Commission report has confirmed that the former Soviet Union had disposed of an unprecedented inventory of radioactive materials, including reactors from nuclear powered vessels, their damaged fuel and other associated materials, in the northern seas. The major inventory was disposed of in the Arctic, specifically in the Kara Sea. The estimates provided by the Yablokov report and the studies by Mark Mount of Lawrence Livermore National Laboratories suggest that the inventory (at the time of disposal) in the Kara Sea area is in the range of at least 1.0 to 2.0 million curies at the lower end estimate and as much as 6.0 to 7.0 million curies at the upper end of the estimate.

In the course of the three conferences, we have been told that much of the disposal was in shallow shelf areas of the Arctic at depths of less than 50 meters. We have also been told that the estimated lifetime for the integrity of certain barrier materials, which was given as several centuries, was not based on *in situ* tests in the Arctic marine environment and seems to have been derived mostly on theoretical grounds, and apparently without consideration of possible disruptive effects of recurring ice scouring. The full analysis of the samples and data sets from the 1992 joint Russian and Norwegian cruise has yet to be published. Also, during the 1992 survey, the ship had been prevented by Russian authorities from visiting the areas near to the actual dumpsites. **That the international efforts have yet to collect data from the Kara Sea dumpsites, in itself, suggests that the opening summary statement in the press releases is premature.**

Also, Stephanie Pfirman of Barnard College/ Columbia University in her poster presentation on ice processes presented at the WHOI conference, provided information that strongly suggests that sea ice can provide potential mechanisms for entraining and transporting sediments (and contaminants) over long distances, even on regional scales. Her presentation on the implications of ice processes was reinforced by statements of other scientists at the Interagency Arctic Policy Research Committee (IARPC) Workshop on Arctic Contamination held in Anchorage just one month before the WHOI conference. It was stressed at the IARPC workshop that shelf ice can scour the shelf and potentially dislodge and/or breach containment systems and barriers at depths of less than 50 meters.

The clear sense communicated by the scientists who addressed these issues at Anchorage was that Arctic ice processes in rivers, on the coast, shelf and open seas provide potential mechanisms for mobilizing, entraining and transporting sediments (and contaminants). At the same time, the seasonality of these and other Arctic processes may provide possible delaying mechanisms so that potential problems may only become manifest at some future time. **In the absence of certain data and in the presence of the existing uncertainties expressed by many participants at the three referenced conferences, we remain cautious in proposing conclusions at this time.**

Concerning the first of our four listed concerns, there was no overall consensus forming or determining process at the conference, nor did the official program statement of the purpose of the conference mention that such a process was being sought. There certainly were no votes taken. Verbal statements were made, and as time allowed some comments and other views expressed. The written press statements were never distributed among participants for comment prior to their release.

The chairman of the working group involved with assessment and remediation issues reported to the WHOI conference that the group was divided on issues regarding impact of past radioactive waste disposal and discharge. He also noted that the necessary experts to assess human health effects and environmental impacts had not been present. As we indicate above, the technical specialties concerned with human health in particular, and to a lesser extent ecosystems effects, did not seem to be sufficiently represented at the conference as a whole to warrant the issuance of a formal press release presenting conclusions in those areas.

We believe that it would be irresponsible based on the present state of knowledge to publish alarmist conclusions. However, it is also inappropriate to conclude that there is no cause for environmental concern among the Arctic nations and communities about potential contamination in their environment or that public health implications can be dismissed out of hand based on current knowledge. WHOI has announced its intention of publishing a formal report of the conference later this summer. **We believe that this formal conference report should be limited to the scientific papers and technical presentations and should not attempt to draw far-reaching conclusions.**

Sincerely,
John M. Diamante
John Diamante
Director, Scientific and Emerging Issues
Office of International Activities

Bob Dyer
Robert Dyer
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Craig E. Dorman/ WHOI
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William Gunter/ EPA
Alan Hecht/ EPA
Charles Hollister/ WHOI
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Radioactivity and Environmental Security in the Oceans
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

6 July 1993

Dear Hugh:

Although, I was able to attend only the first part of the WHOI press conference on Thursday (June 10), I felt that the press release statement did not reflect a fair presentation of the viewpoints expressed at the conference. My initial impression was that the statement represented a few scientists trying to influence government policy and not understanding the full implications, consequences and professional responsibilities, nor the potential personal and institutional liabilities that may be involved in incursions into the domain of policy-making. While the purpose of the conference includes reference to "policy priorities," we need to draw distinction between ***scientific research policy priorities*** (which the group was qualified to address collectively) and the matter of application of scientific information to the broader issues of ***governmental policy*** (which the group as a whole was not qualified to address - for example there was only one person present from the U.S. Department of State). Scientists must be scientifically ***correct,*** whereas policy makers must be ***correct*** within the political context. In these two areas, what is correct may be significantly different. There also is the matter of responsibility to one's colleagues when "speaking" for a conference or any collective forum.

Further, I am concerned that the press statement (neither written nor reviewed by the participants at the meeting) greatly exceeds the experience, legal sensitivities, and professional boundaries represented at the meeting for conducting or evaluating environmental and human health risk assessments, recommending policy is an even more specialized undertaking. The very limited data available from the former Soviet Union (FSU) prohibits any conclusive recommendations. The Office of Naval Research (ONR) is organizing the first major U.S. funded Arctic research program to assess aquatic and marine contamination in the Russian Arctic, and these studies will begin this summer.

In spite of the fact that the WHOI press statement recommends a high priority for research in this area, I am concerned that it may lend itself to being interpreted by policy and decision makers as the basis to discontinue funding future studies. This would be a logical conclusion, since this R&D now can be viewed as clearly NOT needed because the meeting concluded that there was no problem. More seriously the press release may encourage certain factions in the Russian navy, who have already restricted previous cruises, to now take advantage of the situation and once again greatly restrict access to study sites.

Hugh, it may be that others have also written you a note on this matter, and I apologize for the duplication. However, I hope that the subsequent report of the conference will be full of scientific research findings and not dubious statements suggesting policy conclusions. When Bill Ruckelshaus returned to EPA in the mid 80's, I was asked to serve as a senior science advisor in EPA's Office of Policy Planning and Evaluation. In my two years there, I learned a lot about the subtleties of policy and policy-making. Therefore, I urge you to give more consideration to some of the other viewpoints that were expressed at the meeting and to focus the report on the assessment of available data presented at the meeting, the identification and delineation of information gaps, and the information requirements for assessments that speakers and participants identified at the meeting.

I believe that a large part of the "environmental security" of the Arctic is related to non-radioactive contaminants (toxic and hazardous compounds) that have been dumped, discharged or transported there. In the assessments session, many of the participants indicated that the "environmental security" of the greater Arctic was far more influenced by these point and nonpoint source contaminants than radiation "stored" within containment systems or in nuclear submarines. Several of us asked that the issues of these contaminants also be included in the recommendations of future Arctic research needs. You may recall that I brought it up at the final session, after Charlie Hollister neglected to include it in his summary, and yet it was not included in the press statement.

I am sending you a reprint from a special issue of the Marine Pollution Bulletin that I helped write on the roles of research and monitoring in the polar regions. The special issue was dedicated to bringing together some thirty years (and over a 100 million dollars) of Antarctic research funded by the National Science Foundation and the U.S. Navy. The basic conclusion was that we still have a lot to learn about polar environments before we can predict the impact of human activities and the effects of contamination on these ecosystems. If I can be of some help in preparing or reviewing the final report of the conference, please do not hesitate to give me a call. With the significance of the subject matter, it would be very valuable to have the entire report peer reviewed. There are several very good journals that would take on the task and publish the proceedings as a special issue. I am sure that Marine Environmental Research (Elsevier) would be interested.

Sincerely yours,

MChamp

Michael A. Champ
Senior Scientist

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Perspectives

The Roles of Monitoring and Research in Polar Environments

A Perspective

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Do we have enough knowledge about polar ecosystems to ask the right questions when we develop monitoring programmes to assess environmental impacts of human activities?

Researchers have been studying environmental processes in polar regions for more than 30 years. Nevertheless, the information gained has not been sufficient to provide in-depth understanding of the regions studied or most of the processes that occur there. This lack of understanding renders projections of the effects of human activities on terrestrial and marine ecosystems extremely tenuous. Some of the unanswered questions are: *1.* What constitutes a significant impact in environments that are relatively unperturbed by humans? *2.* What methods will minimize the environmental, health, and safety-related risks of living and working in polar regions? *3.* Would the polar regions, due to their pristine nature and remoteness, serve as early warning indicators of global climate change or global pollution?

Polar Environmental Protection Strategies

The need for environmental monitoring in polar regions has been identified at both the scientific and political levels. On 14 June 1981, the eight Arctic circumpolar countries (USA, Canada, Denmark, Iceland, Norway, Sweden, Finland, and the former Soviet Union) signed an Arctic Environmental Protection Strategy which, among other requirements, commits each country to "assess on a continuing basis the threats to the Arctic environment", and to "monitor the levels of, and to assess the effects of, anthropogenic pollutants in all components of the Arctic environment". The current focus of this strategy is on persistent organics, heavy metals, and radionuclides.

The recently completed Protocol to the Antarctic Treaty on Environmental Protection (26 countries) is a comparable adjunct to the Arctic strategy, and recognizes the "unique opportunities in Antarctica for scientific monitoring of and research on processes of global as well as regional importance". It also states that "regular and effective monitoring shall take place to allow assessment of the impacts of ongoing activities, including the verification of predicted impact; ... [and] regular and effective monitoring shall take place to facilitate early detection of possible unforeseen effects of activities carried on both within and outside the Antarctic Treaty area on the Antarctic environment ...".

The Antarctic Treaty Consultative Parties have long recognized the need to protect the Antarctic environment and have requested support from the Scientific Committee on Antarctic Research (SCAR) to provide necessary expert scientific advice: and the Scientific Committee established by the 1980 Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) to begin to implement a plan to monitor key components of Antarctic ecosystems.

In September 1989, the National Science Foundation (NSF) convened a small workshop to develop an effective environmental management plan, which required a clear definition of "environmental monitoring" (Anon., 1989).

The specific goals of the NSF workshop were to:

1. formulate hypotheses on how human activities may affect the Antarctic environment;

2. determine the best types of long-term studies needed to examine these hypotheses;

3. describe the approaches and mechanisms that most likely will provide a better understanding of Antarctic environmental protection;

4. identify the financial and human resources required to implement an environmental monitoring programme; and

5. "prepare a concise set of monitoring guidelines that can be justified scientifically" (Anon., 1989).

Definition of Polar Environmental Monitoring

The Antarctic Treaty Protocol and Annexes on Environmental Protection defines the two main purposes of environmental monitoring to:

- Verify the predicted effects of human activities in the Antarctic on the ecological, scientific, aesthetic, and other values of Antarctica, and other activities in Antarctica; and
- Detect and provide early warning of unforeseen effects.

The Protocol also provides two related objectives to:

- Differentiate between natural changes and changes caused by human activities either in or outside of Antarctica; and
- Document cause-effect relationships.

Discussions at the 1989 NSF workshop, centred on issues that directly affect the US Antarctic Research Program (USARP). The group focused on how the operation and maintenance of Antarctic stations and research programmes already conducted have affected the polar environment. The workshop participants identified the following specific problems that USARP managers need to consider;

- monitoring and disposal of domestic waste water effluents from McMurdo and Palmer Stations;
- surveillance of waste pits at Amundsen–Scott South Pole Station;
- monitoring of leachate and gaseous effluents from the McMurdo Station's burn area (to be used to determine the feasibility and workability of installing incinerators);
- monitoring of contaminants leached from McMurdo Station's old dump and old snow dump (overlooking Winter Quarters Bay);
- monitoring of the water column and sediments in Winter Quarters Bay during ship operations;
- monitoring for the effects of ship and air operations;
- monitoring for the effects of field camp operations;
- using sediment and ice cores to establish historical records near stations;
- continued monitoring of the environment near Palmer Station for effects resulting from fuel spilled by the *Bahia Parasio* in early 1989 (Anon., 1989).

Due to environmental concerns (Anon., 1992; Grotta & Grotta, 1992; Draggan & Wilkniss, 1992; Manheim, 1992; Sabella, 1992; Enzenbacher, 1992), the US Antarctic Program has developed a focus on impacts associated with human activities and operation of facilities at specific sites. However, there is a wider environmental perspective. The agenda of the XV Antarctic Treaty Consultative Meeting in Paris, October 1989, of the countries that are signatory parties to the treaty, included three items that specifically address a comprehensive focus on Antarctic environmental issues including:

- integration of environmental planning and management, as well as monitoring of the human impact on the Antarctic environment, with respect to all activities governed by the Treaty (science, logistics, tourism, etc.);
- furtherance of the integration of Antarctic research into broader international programmes to understand and monitor global change; and
- facilitation of international scientific cooperation to identify research and monitoring programmes that will make a vital contribution to Antarctic research;

Additional workshops were held in Puerto Rico (1st International Ocean Pollution Symposium—May 1991, chaired by M. A. Champ) and two in Washington, D.C. sponsored by EPA (July 1991, chaired by C. Ribic), and by NSF (January 1992, chaired by S. Draggan). At the EPA sponsored workshop a preliminary draft of a research plan for Antarctic biomonitoring was discussed and reviewed.

Use of Environmental Monitoring

If environmental monitoring is only data collection, it will not provide a clear understanding of cause and effect relationships. In the past 20 years, a good portion of environmental monitoring has been decoupled from research and relegated to a lower level in stature. An observation of the lower status that monitoring enjoys is seen in a collection of today's business cards, with titles such as 'research scientist' and not 'monitoring scientist'. Yet when considering the total dollars available for environmental science, a large portion of it is in monitoring and not research. A notable exception is the linkage of monitoring and research conducted by NSF's Long Term Ecological Research (LTER) Program (see Quetin & Ross, 1992).

The benefits of integrating research and monitoring are strikingly demonstrated by the efforts of a few small groups of investigators (see Spellerburg, 1991; and papers in Champ *et al.*, 1987). For example, Bormann & Likens (1987) identified the problem of acid deposition in North America through their work on Hubbard Brook, New Hampshire. Edmondson & Lehman (1981) characterized the role of nitrogen and phosphorus in the eutrophication of Lake Washington and Schindler (1974) determined the role of phosphorus in the productivity of the Canadian Shield Lakes. These investigations had a common research strategy in that research and monitoring were both utilized to acquire critical data appropriate to the identification of ecological patterns and responses with subsequent attribution of causality.

Early polar environmental monitoring studies frequently consisted of repetitive measurement of baseline conditions and detected trends, providing very little insight of the 'why' conditions existed as they did. Often the inability to answer the 'why' questions represented a fundamental limitation of the design of the geographically or ecologically fragmented monitoring efforts. Frequently, even the ability to establish spatial status, or the 'what' question was also limited by a lack of understanding of expected 'normal' variability compounded by no or limited knowledge of the 'representativeness' of the monitoring parameters.

Over time these monitoring efforts repeatedly failed to provide meaningful information on 'causation' to policy and decision makers. It became evident that the field data collection tools could not yield reliable answers. Most of the direct correlation for cause and effect relationships have come from laboratory-controlled experiments. Subsequently, monitoring became less prestigious because the 'why' factors of given environmental issue or change were not within the reach of scientists and engineers at that time.

Recognizing this dilemma, resource managers began to develop comprehensive national monitoring programmes that they could standardize and manage from the top down to gain the necessary information for policy and decision-making. In the US, the National Oceanic and Atmospheric Administration (NOAA) created the National Status and Trends Program (NS&T) to assess contamination trends in coastal fish, shellfish, and surface sediments.

The Environmental Protection Agency (EPA) created the Environmental Monitoring and Assessment Program (EMAP) to focus on ecosystem indicators and not species or organisms *per se*. These programmes were developed to strengthen the value of information from monitoring activities through statistical design innovations, rigorous standard practices, data collection methodologies, analytical procedures, quality assurance (QA) and quality control (QC) measures.

Though relatively new and still undergoing peer review and modification, these monitoring programmes are collecting temporal and spatial data to assess long-term environmental changes and changes to specific indigenous species and/or organisms of commercial fisheries value. The requirements of QA and QC and other standard practices have greatly increased the value of monitoring data, as evidenced from the first five years of NS&T (NOAA 1987, 1989; Wade *et al.*, 1988).

These new monitoring strategies by comparison build on the strength of many years of observation, extensive data bases and knowledge accumulated through research programmes in relevant ecosystems. In many habitat types in the US, there are at least, provisional indicator organisms, environmental criteria and for some issues even environmental standards. This information allows for a more meaningful basis of what, where, when and why to monitor. Only the most rudimentary understandings of pelagic and benthic marine ecosystems surrounding the 29 000 km of Antarctic coastline is currently available. Even the most intensively studied regions (e.g. McMurdo Sound, including the areas immediately adjacent to the US McMurdo Station) provide no comprehensive data sets and only limited insights in naturally occurring seasonal, annual or longer term environmental variations. In the Arctic, an example would be the projection of the movement of nuclear and industrial contamination from the northern regions of the former Soviet Union towards the Arctic Ocean and subsequent dispersion to the Pacific and Atlantic Oceans.

Therefore, for the polar regions, we do not know enough about the spatial and temporal phenomena of events and physical, chemical, and biological processes in polar ecosystems to design meaningful monitoring studies which sample and collect data at the appropriate interfaces, time periods or spatial boundaries.

Polar Management Goals and Objectives

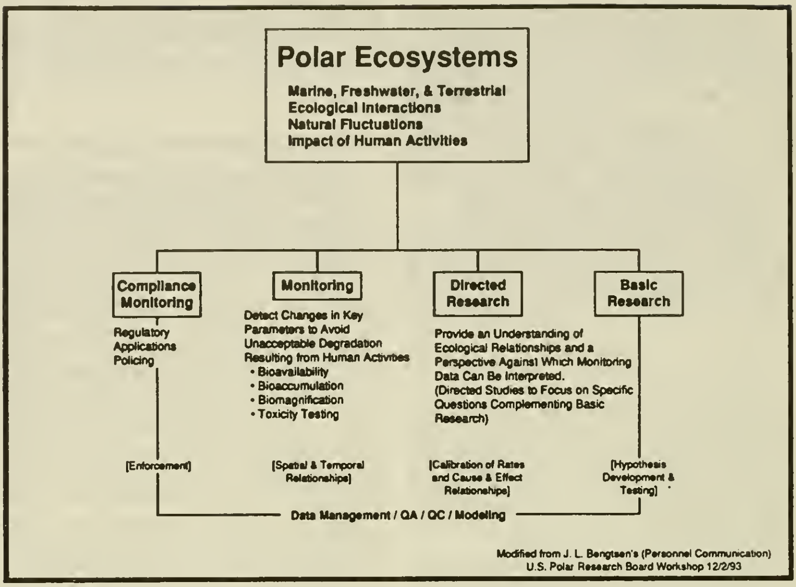
We need to understand what the implicit or explicit environmental goals for the polar regions are before management objectives can be defined. The translation of management objectives into research or monitoring objectives is also required, so that monitoring can measure the performance of how well resource management goals are being met. A graphical illustration delineating the elements of a monitoring and research strategy is presented in Fig. 1. This simple schematic representation is an attempt to delineate the elements and roles of research and monitoring to support environmental management goals and objectives. Subsequent papers by Flemer *et al.* (1986), O'Connor & Flemer (1987), Wolfe *et al.* (1987), Abbott & Benninghoff (1990), Spellerberg (1991), and GESAMP (1991) provide additional discussions and sources of background information on the components of monitoring and research.

Flemer *et al.* (1983) and Abbott & Benninghoff (1990) have identified a number of important guidelines and considerations in the design and development of a monitoring plan which are applicable to the polar regions:

- Management goals must be established in similar environmental zones or regions;
- Objectives must be clearly defined and stated for monitoring which can be used to measure progress in assessing environmental health and to evaluate the success of management efforts;
- Monitoring must be carried out in the context of environmental uncertainty;
- It must be recognized that biological productivity or outputs of an ecosystem, such as fisheries, result from the interaction of a number of ecological processes;
- An ecosystem perspective is essential to appreciate the inter-connecting nature of ecological processes;
- An operational framework that links sources of problem materials with their transport, fate, and effects needs to be maintained;
- Testable hypotheses and predictive models must be formulated;
- An environmental baseline must be established against which to measure the direction and extent of change; and
- Synthesis of programme results, modification, as necessary, of the programme design, and publication of findings is critical to programme success.

Abbott & Benninghoff (1990) identified the following objectives for environmental monitoring as related to the conservation of Antarctic ecosystems:

- Further basic understanding of the structure, range of variability in, and interactions within and between natural systems;
- Verify prediction concerning the effects of natural


Polar Ecosystems
Marine, Freshwater, & Terrestrial
Ecological Interactions
Natural Fluctuations
Impact of Human Activities
Compliance Monitoring
Regulatory
Applications
Policing
Monitoring
Detect Changes in Key Parameters to Avoid Unacceptable Degradation Resulting from Human Activities
• Bioavailability
• Bioaccumulation
• Biomagnification
• Toxicity Testing
Directed Research
Provide an Understanding of Ecological Relationships and a Perspective Against Which Monitoring Data Can Be Interpreted.
(Directed Studies to Focus on Specific Questions Complementing Basic Research)
Basic Research
[Enforcement]
[Spatial & Temporal Relationships]
[Calibration of Rates and Cause & Effect Relationships]
[Hypothesis Development & Testing]
Data Management / QA / QC / Modeling

Modified from J. L. Bengtsen's (Personnel Communication)
U.S. Polar Research Board Workshop 12/2/93

Fig. 1 Conceptual roles of monitoring and research.

phenomena or human activities on variables such as ice formation, nutrient cycling, and primary productivity;

- Detect possible unforeseen effects of human activities on selected variables (see, for example, Benninghoff & Bonner, 1985);
- Evaluate the effectiveness of conservation measures, regulatory mechanisms, and procedures for operating and managing facilities;
- Provide verification or reassurance that the environment is in a healthy state; and
- Obtain baseline information on the environment which may be needed in the future to detect, measure, and monitor future environmental changes.

Polar Environmental Studies

Scientists studying Antarctica have learned that environmental factors—such as the extreme cold and dryness, sea-ice processes, ice scouring, upwelling-induced high productivity levels, and extended periods of light and dark—greatly influence the behaviour, distribution, abundance, and relationships of organisms.

Our present knowledge about polar environments is too limited in many areas to monitor and interpret from the data the impact of human activities. We can measure concentrations of toxic and hazardous materials or selected parameters, but we are not yet able to say what these concentrations mean to the health and quality of life of polar organisms.

Polar research scientists and resource programme managers need to realistically inform policy and decision makers, regulatory bodies, and Congress of the ability to monitor the impact of human activities in polar regions. We need to remind them 'up front' that the knowledge base of polar ecosystems is such that we do not have a complete enough understanding to make predictions about processes, pathways, fate and effects of contaminants or cause and effect relationships. Before we can do this, we must invest in collecting descriptive baseline data, very routine information which is invaluable in designing an appropriate monitoring programme. The generation of long-term environmental information is especially expensive and time-consuming to collect in the polar regions. Further impediments to the collection of these necessary time series are also found in the disincentives associated with the policies of both academic and research institutions, governmental research, and regulatory agencies, so that today such records are uncommon (Wolfe *et al.*, 1987). From the perspective of environmental management, it is important to define as completely as possible the specific management needs (i.e. policy questions) for which data and information will be used, including scoping studies to ensure that adequate statistical resolution can be achieved in those areas where changes important to resource managers are occurring.

We must not forget that the objective of monitoring is to determine qualitatively the nature of the environment and whether it has changed from its 'reference state'. Monitoring is a part of field validation. Research, whether conducted in the laboratory or field, is an analytical approach to understanding ecological complexities, establishing causal relationships, and making predictions. So, in an applied context, monitoring and research are complementary in gaining useful information and knowledge.

Therefore, because of our limited knowledge of polar ecosystems, the term 'monitoring' should be very narrowly defined in a regulatory sense. It should be limited to determine compliance with or deviation from established discharge or emission environmental standards or associated environmental quality criteria, or performance of selected environmental indicators across spatial or temporal boundaries (and to not just monitor change). The bulk of the necessary information must be collected through basic environmental research. This means that considerable information and knowledge need to be developed for a given ecosystem in which meaningful measurements could be identified and monitored. For the polar regions, there are no environmental water quality or environmental criteria or standards, or validated environmental (biological) indicators. Therefore, we need more research in the polar regions before we can intelligently design or meaningfully interpret data from polar monitoring activities.

An appreciation of spatial and temporal scales is a critical feature in coupling field monitoring and research. The issue of scale is a key factor in the formal definition of the terms ecosystem (Flemer *et al.*, 1986), and pollution (Champ, 1983). It is very difficult to extrapolate from laboratory to the field, as was seen in the 96-h bioassay, which was designed as the function of a 5 day work week and not a scientific experiment (White & Champ, 1984).

Research, especially experimental reductionism and field manipulation are important in addressing causality at relatively small scales where single processes may dominate system response but is limited even here. In relatively small habitat types, e.g. small lakes, one can perform holistic 'experiments' (see Champ *et al.*, 1973), but this approach is limited in larger systems. Therefore, conceptual models (and they are the springboards to other types of models) are used to address issues of organizational complexity, patchiness, non-linear responses (deterministic chaos), variance that occurs simultaneously at multiple scales of observation (i.e. when the windows of observation sets the scale of variability), positive and negative feedback loops, and mechanisms of amplification and attenuation (i.e. homeostatic). Research has limited 'tentacles' into ecological reality whereas monitoring reaches across larger scales of system structure and processes.

Also the problems of generality, precision and controllability are not trivial. Unfortunately, the secret of an *a priori* scheme of how to optimize research and monitoring for a given question, is perhaps not readily available for polar regions, the identification and delineation of the elements is a critical early stage.

Questions for Polar Research

- What are the criteria for an undesirable environmental change in polar regions?
- What are the natural resource objectives for polar regions under the influence of developed nations?
- To what extent would polar regions, due to their relative remoteness from industrialized centres, serve as early warning sentinels of global climate change?
- What is the risk of changing the dynamic 'natural' state of these systems relative to the several scenarios?
- What is the resilience and resistance of polar ecosystems to respond to internal stress posed by human activity and ability to respond to outside perturbations at their boundaries?
- Although implicit, we need to acknowledge that the 'simpler' Arctic and Antarctic realms are perhaps more difficult ecosystems to understand with their own system dynamics and vulnerabilities.

For the Arctic Polar Regions

- What are some likely scenarios of human intervention, especially non-native industrialized peoples, in polar regional ecosystem processes over the next several decades? This question considers what we think the nature of environmental 'insults' will be if the objective is to maintain the so-called natural condition. A corollary to this question is what life cycles are likely to be affected by habitat modification, contaminant stress or changes in patterns or disease?
- What is the state of knowledge with regard to an assessment of the vulnerability of these systems to human intervention? The concern here is that developing country's technology is probably changing the way native peoples of the Arctic affect their environment.
- And, of course, what extent do native peoples of the North Polar regions ultimately have a say in how their polar environmental resources are to be used? Since there are cultural differences, how will their concerns be addressed?

Agenda for Polar Environmental Research

Effective environmental resource management requires knowledge of detrimental effects that occur in polar environments and the factors that cause those effects. This requires the ability to distinguish variability associated with human activities resulting in ecosystem response from natural spatial, temporal and sampling variability.

Some key factors that environmental polar research needs to address are:

- establish high quality baseline data sets of current condition;
- temporal and spatial scale considerations;
- field validation;
- conceptual models;
- collection of long-term data sets;

- scoping exercises;
- linkages among key ecosystem components (atmosphere, terrestrial, freshwater, and marine);
- detailed analyses of environmental problems;
- identification and development of criteria for useful environmental indicators/indices; and
- validation of environmental indicators/indices.

The US EPA has implemented the Arctic Contaminants Research Program (ACRP) and published a research plan (Landers *et al.*, 1991) to fulfil its obligation to support the US Interagency Arctic Research and Policy Committee (IARPC—of 12 US federal agencies) and the Arctic Environmental Protection Strategy, and its interest in the assessment of global toxic emissions.

The ACRP integrates some of the above research agenda. The programme focuses on the current levels of atmospherically transported and deposited contaminants in snow, regional lichen, moss and soil samples, lake sediments, and biota (food webs) in order to establish the status and extent of pollution in Arctic ecosystems. Recent studies of organochlorines in the Canadian Arctic have suggested that the magnitude and extent of Arctic contamination from long-range atmospheric transport may be more significant than previously realized (Muir *et al.*, 1988; Norstrom *et al.*, 1988; Bidleman *et al.*, 1989). Air currents are postulated to move toxicants from the industrial areas to the Arctic polar regions. For the Antarctic, the air masses come from the less-developed countries, transporting agricultural pesticides, such as DDT (Goldberg, 1975; Risebrough, 1986), and as detected in Antarctic species (Schrader, 1980) or the shift in DDT/DDE ratios as observed by Joiris & Overloop (1989). The relative importance of surface slicks as a long-term transport mechanism needs to be clarified.

At the EPA (1991) sponsored workshop on biomonitoring (chaired by C. Ribic) it was discussed that for the Antarctic, most of the contaminant research to date had considered the biota in isolation from the ecosystem, making it difficult to interpret the ecological significance of toxic contaminants to the biota or to the system. The workshop participants proposed the need for the linkage of exposure assessment and ecosystem research efforts for greater understanding of global pollution impacts in the Antarctic. With the atmospheric inputs of sources of contaminants to the Antarctic being postulated as the major pathway, the following criteria were suggested as a guide for selecting chemical compounds of interest for long-term research projects:

- identifiable primary source from atmospheric deposition;
- persistence and mobility of the primary compound or metabolites in the environment;
- bioaccumulation and biomagnification with low variability in food chains;
- available analytical methodology for the chemical and biological sampling;
- preservability of tissues and analytes for archival analysis;
- sensitivity to adverse physiological and ecological effects in biota; and
- sufficient abundance of indicator organisms.

Recent Developments

The National Science Foundation (NSF) has sponsored basic environmental research in Antarctica since 1988 that has specifically addressed environmental impacts associated with human presence in Antarctica. Several papers presented in this special issue of the Marine Pollution Bulletin have been supported by NSF. Program Managers in the Division of Polar Programs at the Foundation have recently indicated (4 January 1993) that NSF is currently considering developing an expanded formal programme solicitation to support a wider array of polar environmental research. The National Oceanic and Atmospheric Administration (NOAA) funded in 1991, the first NS&T sampling programme in the Antarctic (Wade & Kennicutt, pers. comm.).

Conclusion

Environmental monitoring coupled with research provides a mutually beneficial synergism which allows scientists to: *1.* efficiently monitor the environment using sensitive, relevant environmental signals to detect and quantify change, *2.* determine when change is ecologically significant, and *3.* determine the cause of change. From the perspective of potentially large-scale ecosystem impacts where causality is an objective, we believe that environmental monitoring (i.e., research-focused monitoring) is essential and serious decoupling of monitoring and research in this context is a weak strategy and a questionable environmental policy.

> *The perspective of this paper is that we need to be very realistic in informing policy and decision makers about the ability to monitor the impact of human activities in polar regions and setting environmental guidelines.*

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The information in this document has been subjected to the US Environmental Protection Agency peer and administrative review, and it has been approved for publication.

Abbott, S. B. & Benninghoff, W. S. (1990). Orientation of environmental change studies to the conservation of Antarctic ecosystems. In *Antarctic Ecosystems* (K. R. Kerry & G. Hempel, eds), pp 394–403. Springer-Verlag, New York.

Anon. (1989). Experts gather to discuss long-term environmental monitoring. *Antarctic Journal* December, 4–7.

Anon. (1992). Poles apart, science thrives on thin ice. *Science.* **255**, 276–277.

Benninghoff, W. S. & Bonner, W. N. (1985). Man's impact on the Antarctic environment: a procedure for evaluating impacts from scientific and logistic activities. Scientific Committee on Antarctic Research, Scott Polar Research Institute. Lensifeld Road, Cambridge.

Bidleman, T. F., Patton, G. W., Walla, M. D., Hargrave, B. T., Vass, W. P., Erickson, P., Fowler, B., Scott, V. & Gregor, D. J. (1989). Toxaphene and other organochlorines in Arctic Ocean fauna: evidence for atmospheric delivery. *Arctic* **42**. 307–313.

Bormann, F. H. & Likens, G. E. (1987). Changing perspectives and air-pollution and stress. *BioScience* **37**(6). 370.

Champ, M. A., Lock, J. T., Bjork, C. D., McCullough. J. C., Jr. & Klussman. W. G. (1973). Effects of anhydrous ammonia on a central Texas Pond. *Trans. Am. Fish. Soc.* **102**(1). 73–82.

Champ. M. A. (1983). Etymology and use of the term "pollution". *Can. J. Fish. Aquat. Sci.* **40** (Supp. 2). 5–8.

Champ. M. A., Wolfe, D. A., Flemer. D. A. & Mearns, A. J. (1987). Dedicated Issue Long-Term Biological Records. *Estuaries* **10**(3). 181–275.

Draggan. S. & Wilkniss, P. (1992). An operating philosophy for the US Antarctic Programme. *Mar Pollut. Bull.* **25**, 250–252.

Edmondson, W. T. & Lehman, J. T. (1981). The effect of changes in the nutrient income on the condition of Lake Washington. *Limnol. Oceanogr* **26**. 1–29.

Enzenbacher. D. J. (1992). Antarctic tourism and environmental concerns. *Mar. Pollut. Bull.* **25**, 258–265.

Flemer. D. A., Davidson, L. C., Price. K., Mackiernan, G. B. & Johnson, B. (1983). A monitoring and research strategy to meet management objectives. From Chesapeake Bay: A Framework for Action. US EPA. Region 3, Philadelphia. Appendix F. 1–22.

Flemer. D. A., Duke, T. W. & Mayer. F. L., Jr. (1986). Integration of monitoring and research in the near-shore coastal waters. Published in the Proceedings of Oceans '86 Conference. Vol. 3: 980–992. The Marine Technology Society. Washington, D.C. and reprinted (adapted by M. A. Champ) in *Sea Tech.* 27(9). 10–17.

GESAMP (1991). Global strategies for marine environmental protection. GESAMP Reports and Studies. No. 45.

Goldberg, E. D. (1975). Synthetic organohalides in the sea. *Proc. R. Soc. London. B.* **189**, 277–289.

Grotta, D. & Grotta. S. (1992). Antarctica: Whose continent is it anyway? *Popular Science* January, 62–91.

Joiris, C. & Overloop, W. (1989). PCBs, organochlorine pesticides and mercury in the lower trophic levels of the Antarctic marine ecosystem. Terres Australes et Antarctiques Francaises, Mission de Recherche, Papports des Campagnes.

Landers, D. H., Ford. J., Gubala, C. P., Allen. S., Curtis, L., Urquhart, N. S. & Omernik, J. M. (1992). Arctic contaminants research program research plan. U.S. Environmental Protection Agency, Corvallis, Oregon, EPA/600/R-92/210.

Manheim, B. S., Jr. (1992). The failure of the National Science Foundation to protect Antarctica. *Mar. Pollut. Bull.* **25**, 253–254.

Muir. D. C. G., Norstrom, R. J. & Simon. M. (1988). Organochlorine contaminants in Arctic marine food chains: accumulation of specific polychlorinated biphenyls and chlordane-related compounds. *Environ. Sci. Technol.* **22** 1071–1079.

NOAA (National Oceanic and Atmospheric Administration) (1987). A summary of selected data on chemical contaminants in tissues collected during 1984, 1985, and 1986. National Ocean Service. Technical Memorandum NOAA OMA 38.

NOAA (National Oceanic and Atmospheric Administration) (1989). A summary of selected data on tissue contamination from the first three years (1986–1988) of the Mussel Watch Project. National Ocean Service. Technical Memorandum NOAA OMA 49.

Norstrom. R. J., Simon. M., Muir. D. C. G., & Schweinsburg, R. E. (1988). Organochlorine contaminants in Arctic marine food chains: identification, geographical distribution and temporal trends in polar bears. *Environ. Sci. Technol.* **22**, 1063–1071.

O'Connor, J. S. & Flemer, D. A. (1987). Monitoring, research, and management: Integration for decision-making in coastal marine environments. In *New Approaches to Monitoring Aquatic Ecosystems* (T. P. Boyle, ed.), pp. 70–90. American Society for Testing and Materials, Philadelphia.

Quentin, L. B. & Ross, R. M. (1992). A long-term ecological research strategy for polar environmental research. *Mar. Pollut. Bull.* **25**, 233–238.

Risebrough, R. W. (1986). Pesticides and bird populations. *Current Ornithology* 3, 397–427.

Sabella S. J. (1992). Upon closer inspection ... *Mar. Pollut. Bull.* **25**, 255–257.

Schindler, D. W. (1974). Eutrophication and recovery in experiential lakes; implications for lake management. *Science* **184**, 897–899.

Schrader, G. (1980). Environmental investigations during the 20th Soviet Antarctic Expedition telation to occurrence of the soil of resistant phyla of clostridia and to distribution of DDT in Antarctic fauna. *Geodatische und Geophsikalische Veroffentlichungen* **1**, 178–182.

Spellerberg, I. F. (1991). *Monitoring Ecological Change.* Cambridge University Press, New York.

Wade, T. L., Atlas, E. L., Brooks, J. M., Kennicutt II, M. C., Fox, R. G., Sericano, J., Garcia-Romero, B. & DeFreitas, D. (1988). NOAA Gulf of Mexico Status and Trends Program: Trace organic contaminant distribution in sediments and oysters. *Estuaries* **11**, 171–179.

White, H. H. & Champ, M. A. (1984). *The Great Bioassay Hoax, and Alternatives.* American Society for Testing and Materials, Special Technical Publication 805 (pp. 299–312).

Wolfe, D. A., Champ, M. A., Flemer. D. A. & Mearns, A. J. (1987). Long-term biological data sets: Their role in research, monitoring, and the management of estuarine and coastal marine systems. *Estuaries* **10**(3), 181–193.

June 10, 1993

Statement

There is a strong consensus among conference participants that there is no evidence of any regional scale radioactive contamination in the Arctic and North Atlantic Oceans that currently poses a threat to human health or causes environmental concern. The group agreed that further sampling and modelling are required to define and assess the status of very localized effects from materials disposed of within the Barents and Kara Seas. While it would be prudent to inspect all locations, any potential problem would be a local one and would pose no threat on a global scale.

As regards other threats from nuclear activities and materials, one of the most serious was felt to be the potential for contamination of the Arctic as a result of releases of radioactive materials currently stored on land. Principal among these is the delivery of radioisotopes by rivers as a result of releases of some of the major amounts of nuclear waste from weapons plants and other nuclear facilities stored in the water sheds of these rivers. Also of major concern was the potential for release from the large quantities of nuclear fuel stored on land and the nuclear reactors of decommissioned submarines presently afloat in the shallow water bays of this region. Further, there was clear consensus that the nuclear submarines and contained weapons lost in the deep sea (depths greater than 1500 meters) do not pose any significant present or future threat to human health or the environment in which they lie.

Conference participants called for further studies in the Barents and Kara Seas. Participants considered whether a new international organization was needed for this purpose, but concluded that a number of government and international organizations already exist with responsibilites in this area and called for stronger coordination among these agencies and between these agencies and the international scientific community.

Participants made a number of recommendations:

-- declassification of all existing data regarding nuclear materials in the ocean.

-- a continuing series of international workshops to assess and compare data and develop models for better understanding of the fate of radioactive material in the ocean.

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Statement Page 2

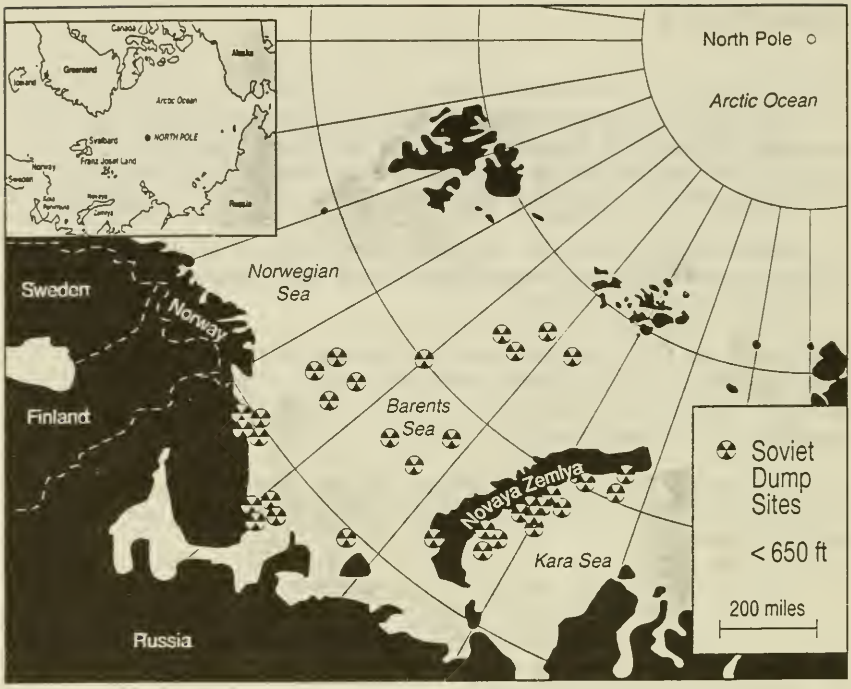
-- establishing international protocols and standarized procedures for archiving materials and conducting scientific sampling. Russian participants in the conference expressed a clear willingness to share data and samples, and to open their archives to the international community.

-- studies involving the social and psychological impacts on the 8-10 million people living in the Arctic region and a greater sharing of information with these people.

The group called on the international community, including government and private agencies, to consider funding this research as a high priority, and urged that decision-making on this topic be rooted in scientific assessment rather than emotional reaction.

To begin some of this work, five cruises are planned by three nations (Norway, Russia and the U.S) this summer to the Barents, Kara and Norwegian Seas.

This statement was read by Dr. Hugh D. Livingston, Woods Hole Oceanographic Institution, Chairman, Conference Planning Committee.



Prepared by the WHOI Graphics Department for *Environmental Security and the World Oceans: Shared US and Russian Perspectives*, James M. Broadus and Raphael V. Vartanov, editors, forthcoming from Island Press.

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

19 July 1993

Mr. Michael A. Champ
7000 Vagabond Dr.
Falls Church, VA 22042

Dear Michael,

Thank you for your letter of 6 July expressing your concern about the WHOI conference press release. I am sorry that you were concerned and felt the need to write in response.

I may say that it seems to represent a minority opinion from all the input we have received since the conference but, as you know, it is not possible to please all of the people all of the time.

I must disagree with your impression that the statement was an attempt to influence goverment policy. It was rather an attempt to present the sense of the issues discussed at the meeting. We believe that the meeting addressed many concerns about ocean radioactivity issues in a responsible and sound scientifically based manner. If this comes out as counter to the alarmist media coverage of this subject over the recent past then I feel we are honestly fulfilling our responsibilities as scientists in restoring the imbalance in public discussion of these matters.

You mentioned the limited data which prohibited conclusive recommendations. On the contrary we can cite you the very extensive reports of U.S., Russian, Canadian, Danish, U.K. and German scientists who have made extensive radioisotope measurements throughout much of the Arctic over the last 20 years or so which consistently do not reveal any surprise amounts or sources of radioactivity other than those from known sources which have been shown to be trivial health or environmental issues. Therefore our first statement I believe is on very solid ground when it notes that "there is no evidence of any REGIONAL scale radioactive contamination in the Arctic or North Atlantic Oceans that CURRENTLY poses a threat...... concern." (MY CAPITALS).

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Then I think you will find that the publication of the proceedings of the meeting will indeed be full of the science presented there, of the reports of the Working Groups and of the Plenary Discussion. I think many of your concerns in this respect will be covered. In particular the issues of non-radioactive contaminants will be present as it was brought up. It was not highlighted as it was not the meeting focus.

Finally we had already considered and decided against the idea of publishing the proceedings in a peer reviewed journal. We think it better to get it out in a timely manner and let it be judged in its own merits.

Thank you again for your thoughts on these matters. I hope that the proceedings will satisfy the needs of you and the other participants.

Yours sincerely,

Hugh D. Livingston
Chairman, Conference Planning Committee

HDL/mz

cc: C.D. Hollister
C.E. Dorman
L.A. Codispoti
D. Nagel
B.F. Molnia
T. DeLaca
J.M. Brooks

WOODS HOLE OCEANOGRAPHIC INSTITUTION
1930

20 July 1993

Dr. John Diamante
Director, Scientific and Emerging Issues
Office of International Activities

Dr. Robert Dyer
Deputy Director, Program Development
Criteria and Standards Division
Office of Radiation and Indoor Air
United States Environmental Protection Agency
Washington, DC 20460

Dear John and Bob,

Thank you for your letter of 7 July expressing your concern about the WHOI conference press release. I am sorry that you were concerned and felt the need to write in response.

Nothing that has happened since the conference has altered our view that the press release was a fair and honest assessment of the issues discussed and conclusions reached at the conference and we stand behind it. Enough well respected and qualified participants who attended the meeting have told me that they concurred with the sentiments expressed in the press release. So I am forced to conclude that the wording of the text made you uncomfortable. I will try to expand on this as I go through your letter.

You mentioned the lack of essential data which prohibited conclusive recommendations. On the contrary we can cite you the many reports of U.S., Russian and Canadian, Danish, U.K. and German scientists who have made extensive radioisotope measurements throughout much of the Arctic over the last 20 years or so which consistently do not reveal any surprise amounts or sources of radioactivity other than those from known sources which have been shown to be trivial health or environmental issues. Some of these data were presented at the Oslo and Woods Hole meetings at least (I am not sure about

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Anchorage as I was not there). But in any case the relevant data have been published in a number of papers both in the reviewed literature and in extensive reports. This literature is very familiar to many conference participants who follow the literature on oceanic radioactivity closely. Therefore our first statement I believe is on very solid ground when it notes that "there is no evidence of any REGIONAL scale radioactive contamination in the Arctic or North Atlantic Oceans that CURRENTLY poses a threat ...... concern." (MY CAPITALS).

You are correct when you note the Kara Sea inventory estimates from Yablakov and Mark Mount. You choose to emphasize the estimates at time of dumping as opposed to current level estimates. This is exactly the trend of presenting the facts in the most unfavorable manner possible which has characterized media coverage so far. Neither the press statement nor the conclusions from the conference downplay the concerns about these sources. But they will present them as fairly and responsibly as possible, with proper comparison to comparable sources which have introduced artificial radioactivity to the oceans. And the need for assessment of purely local effects from these sources was properly noted. So the OPENING SUMMARY STATEMENT WAS NOT PREMATURE - ONLY ACCURATE AND HONEST.

Of course ice processes may rupture sources and transport contamination. That IS one of the conference conclusions. Not all could or should be in a press release.

On the consensus forming issue, I will only say that the final plenary session was an opportunity to comment on contentious issues, all participants were invited to attend and participate in the press briefing and many did. This was not an election and, sure, no votes were taken. The press release was prepared in the short overnight prior to the morning briefing by the people who had been entrusted by the funders of the conference to organize this meeting. Their professional competence and intellectual honesty was clearly established and I think they discharged their responsibilities as effectively as time permitted.

My review of my notes and taped recording of Chris Garrett's report to the conference of the Assessment/Remediation group do not reveal the divisive comments you attribute to him. In fact the presentation of the conclusions of this group were properly cautious and left unanswered the assessment of sources or areas where insufficient information was available. The ICRP approach to assessment was the basis for the group's work. That approach is widely accepted as soundly based in respect of health and ecosystem protection so representation of specialists from these areas hardly alters the cautious conclusions of this group.

Then I think you will find that the publication of the proceedings of the meeting will indeed be full of the science presented there, of the reports of the Working Groups and of the Plenary Discussion. I think many of your concerns in this respect will be covered.

Yours sincerely,

Hugh D. Livingston

Hugh D. Livingston
Chairman, Conference Planning Committee

HDL/mz

cc: James Broadus/ WHOI
Craig E. Dorman/ WHOI
Gene Durman/ EPA
Wendy Grieder/ EPA
William Gunter/ EPA
Alan Hecht/ EPA
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